Section 2
Alternatives Analysis

As described in Section 1, nine alternatives were initially identified to accomplish the purpose of and need for the Luce Bayou Interbasin Transfer Project and provide for the transfer of water from the Trinity River to Lake Houston or the City of Houston NEWPP. The environmental constraints analysis presented in Section 1 quantitatively addressed these nine alternatives. The alternatives that represent favorable construction and environmental impacts based on the criteria selected for analysis (Alternatives 2 and 3) were identified and are to be evaluated in more detail in this section. As warranted based on available data, detailed analyses presented below were conducted within the area of impact defined as a 300-foot corridor centered along the centerline of Alternative 2 and 3.

It should be noted that the alignments of the proposed Alternatives 2 and 3 are preliminary. The final alignments of these alternatives would be refined after more detailed analysis is completed to avoid environmental impacts (i.e. floodplain, wetlands, archaeological, threatened and endangered species, and the golf course) to the extent possible.

2.1 Alternatives Analysis

For the alternatives analysis conducted for Alternatives 2 and 3, recent topographic maps, soil survey maps, floodplain maps from FEMA and TSARP data, NWI maps, aerial photographs (2004), and stream segment maps were obtained and reviewed. Oil and gas location maps were obtained from a private vendor, GeoMap® Inc., and public records from the RRC of Texas were also obtained and reviewed. Cultural resource investigations conducted for the Luce Bayou project were obtained and examined, and recorded archeological site locations were identified.

The alternatives analysis provided in this section focuses on Alternatives 2 and 3 specifically the area of impact defined as within 150 feet on each side of the centerline of each alternative (i.e., 300-foot corridor). Similar to Section 1, the alternatives analysis is a desktop study conducted at a broad scale to select the alternative for further study consideration. As such, this analysis was conducted with the best available data assuming a reasonable level of accuracy for this phase of the analysis. In general, field verification was not conducted, although limited field reconnaissance from available roadways was performed and consultation with resource and regulatory agencies was initiated.

2.1.1 Prime Farmland Soils

Prime farmland soil information was obtained from the USDA NRCS soil surveys for Harris and Liberty Counties. Prime farmland would either be impacted by subterraneous pipeline, constructed water channel, or an existing watercourse with some expected widening. *Exhibit 7* shows areas where the evaluated alternatives traverse prime farmland. Acres of prime farmland soils to be impacted for Alternatives 2 and 3 were examined by plotting the soil mapping units from the NRCS 1996 Soil Survey of Liberty County and 1976 Soil Survey of Harris County into ArcGIS within the 300-foot area of impact. The soil surveys were used to categorize soils as prime farmland soils.

Prime farmland soils that would be affected by Alternative 2 includes: Aldine silt loam, 0 to 2 percent slopes (AdA), Waller Loam (Wa), Vamont clay, 1 to 3 percent slopes (VaA), Waller-Dallardville complex (Wd), Waller-Kirbyville complex (Wk), Sorter loam (Sb), Kirbyville fine sandy loam (Kr), and Owentown fine sandy loam, occasionally flooded (Oz), a total of approximately 1,914 acres of prime farmland soils. The prime farmland soils that would be affected by Alternative 3 include: AdA, Wa,

VaA, Wk, Wd, Sb, League clay, 0 to 1 percent slopes (LaA), Bernard-Morey complex (BmA), Beaumont Clay (Ba), Mocarey-Yeaton complex (My), Bevil silty clay, depressional (Vd), Vamont Clay, 1 to 3 percent slopes (VaB), Midland silty clay loam/Verland silty clay loam (Md), and Lake Charles Clay, 0 to 1 percent slopes (LcA), a total of approximately 1,754 acres of prime farmland soils.

A portion of the alternatives would be subterraneous or in existing watercourse channels; therefore, these portions of the alternatives would most likely have minimal impacts to farmlands. However, an approximate 16,000-foot section of Alternative 2 and 122,500-foot section of Alternative 3 would be a constructed water canal, permanently removing existing prime farmland.

Aerial photography and appraisal districts maps were examined to identify agricultural areas or farms that might be divided by the channel or pipeline. Alternative 2 would divide one farm that appears to be used for tree farming. Minimal farm damage is expected by Alternative 2 because a majority of the property is already divided by Luce Bayou. Alternative 3 would impact a total of six farms including farms that appear to be used for tree farming, rice farming, soybeans and other crops, or are identified by the Liberty County Appraisal District as property in agricultural, horticulture or forest production.

2.1.2 Threatened and Endangered Species

The 1973 Endangered Species Act (ESA) regulates a wide range of activities affecting flora and fauna classified as endangered or threatened. Reauthorized in 1988, provisions of the act apply only to species listed in the Federal Register as endangered or threatened. Under the provisions of the ESA, all federal agencies are required to undertake programs for conservation of threatened and endangered species and are prohibited from authorizing, funding, or carrying out actions that would jeopardize a listed species or destroy or alter its critical habitat.

The USFWS and the National Marine Fisheries Service (NMFS) share responsibility for administration of the ESA. In general, the USFWS is responsible for terrestrial and freshwater species and migratory birds, while the NMFS regulates and protects marine species and anadromous fish.

The State of Texas also has enacted laws regulating threatened and endangered species. In 1973, the Texas legislature authorized the Texas Parks and Wildlife Department (TPWD) to establish a list of endangered and threatened animals in the state. TPWD regulations prohibit the taking, possession, transportation, or sale of species designated by state law as endangered or threatened without a permit. State laws and regulations prohibit commerce in threatened and endangered plants and the collection of listed species on public land without a permit issued by TPWD. These laws apply to individuals, municipalities, and all organizations.

The potential presence of federal and state listed threatened and endangered species and species of concern were evaluated using data from USFWS and TPWD websites. Data from the TPWD Natural Diversity Database (NDD) was also obtained for known elements of occurrence for the area surrounding the Alternatives 2 and 3. A map of the locations of the NDD elements of occurrence is presented in *Exhibit 8*. The elements of occurrence listed by the NDD in the vicinity of Alternatives 2 and 3 are primarily located adjacent to the Trinity River. Elements of occurrence depicted on *Exhibit 8* are for planning purposes only. The data should not be reproduced or made available for public viewing. A list of threatened and endangered species occurring in Harris and Liberty Counties was compiled, which includes the generalized habitat preferences of each species (*Table 4*). Habitat preferences were compared to habitats interpreted from aerial photographs and National Oceanic and Atmospheric Administration (NOAA) GIS land cover data in order to predict the potential presence of these species.

Alternatives 2 and 3 are in relative proximity, and, in some areas, share a common corridor; therefore, plant and animal species potentially inhabiting the area of impact for each alternative may be the same. There are three species listed as federally threatened or endangered in Harris and Liberty Counties, while 49 species are listed as state threatened, endangered, or as a species of concern in the two counties. *Table 4* lists the species, the county of listed occurrence, the species' state and/or federal status, habitat preference, and if that species' habitat could be interpreted by NOAA land cover data as occurring in the project area. Of the species listed on the TPWD county lists and the USFWS-Southwest Region county lists, 29 species have potential habitat in the vicinity of Alternatives 2 and 3.

Table 4. State and Federal Listed Species Known to Occur in Liberty and Harris Counties

Common Name	Scientific Name	State Status[1]	Federal Status[2]	County of Occurrence	Habitat Description	Habitat Potentially Present
Amphibians						
Houston Toad	*Bufo houstonensis*	E		Harris & Liberty	Sandy soil, breeds in ephemeral pools	No
Birds						
Artic Peregrine Falcon	*Falco peregrinus tundrius*	T		Harris & Liberty	Potential migrant; winters along Texas Gulf Coast	Yes
Bachman's Sparrow	*Aimophila aestivalis*	T		Liberty	Scattered bushes, overgrown hills or fields	Yes
Bald Eagle	*Haliaeetus leucocephalus*	T	T, PDL	Harris & Liberty	Near rivers, lakes; nests in large trees	Yes
Black Rail	*Laterallus jamaicensis*	SOC		Harris	Salt, brackish, freshwater marshes	No
Brown Pelican	*Pelecanus occidentalis*	E		Harris	Coastal and near shore areas	No
Henslow's Sparrow	*Ammodramus henslowii*	SOC		Harris & Liberty	Weedy fields	Yes
Mountain Plover	*Charadrius montanus*	SOC		Harris	Plains and prairies	Yes
Red-Cockaded Woodpecker	*Picoides borealis*	E	E	Harris & Liberty	Cavity nests in older pine	Yes
Southeastern Snowy Plover	*Charadrius alexandrinus tenuirostris*	SOC		Harris	Wintering migrant along Texas Gulf Coast	No
Swallow-Tailed Kite	*Elanoides forficatus*	T		Liberty	Lowland forested region	Yes
White-Faced Ibis	*Plegadis chihi*	T		Harris & Liberty	Prefers freshwater marshes, sloughs and irrigated rice fields	Yes
White-Tailed Hawk	*Buteo albicaudatus*	T		Harris	Prairies, mesquite and oak scrub or savannahs	Yes
Whooping Crane	*Grus americana*	E		Harris	Potential migrant via plains throughout most of the state	No
Wood Stork	*Mycteria americana*	T		Harris & Liberty	Roots in tall snags and forages in shallow standing water.	Yes

Table 4. State and Federal Listed Species Known to Occur in Liberty and Harris Counties *(continued)*

Common Name	Scientific Name	State Status[1]	Federal Status[2]	County of Occurrence	Habitat Description	Habitat Potentially Present
Fish						
American Eel	*Anguilla rostrata*	SOC		Harris & Liberty	Muddy bottoms, still waters, large streams, lakes, brackish estuaries with access to ocean	No
Creek Chubsucker	*Erimyzon oblongus*	T		Harris & Liberty	Variety of small rivers and creeks, prefers headwaters	Yes
Paddlefish	*Polyodon spathula*	T		Liberty	Large, free-flowing rivers, also frequents impoundments with access to spawning areas	Yes
Mammals						
Black Bear	*Ursus americanus*	T		Harris & Liberty	Bottomland hardwoods; large, undisturbed forests	No
Louisiana Black Bear	*Ursus americanus luteolus*	T		Liberty	Bottomland hardwoods; large, undisturbed forests	No
Plains Spotted Skunk	*Spilogale putorius interrupta*	SOC		Harris & Liberty	General; woods, fields, prairies, shrub	Yes
Rafinesque's Big-eared Bat	*Corynorhinus rafinesquii*	T		Harris & Liberty	Cavity trees in hardwood forest, concrete culverts, abandoned buildings	Yes
Southeastern Myotis	*Myotis austroriparius*	SOC		Harris & Liberty	Cavity trees in hardwood forest, concrete culverts, abandoned buildings	Yes
Mollusks						
Little Spectaclecase	*Villosa lienosa*	SOC		Harris & Liberty	Creeks, rivers, reservoirs, sandy substrates in slight to moderate current, usually along banks	Yes
Louisiana Pigtoe	*Pleurobema riddellii*	SOC		Harris & Liberty	Streams and moderate-size rivers; usually flowing water on substrates of mud, sand, and gravel	Yes
Pistolgrip	*Tritogonia verrucosa*	SOC		Harris & Liberty	Large rivers with rock, hard mud, silt, and soft bottoms, often buried deeply	Yes
Rock-Pocketbook	*Arcidens confragosus*	SOC		Harris & Liberty	Mud, sand, and gravel substrates of medium to large rivers in standing or slow flowing waters	Yes
Sandbank Pocketbook	*Lampsilis satura*	SOC		Harris & Liberty	Small to large rivers with moderate flows and swift current on gravel, gravel-sand, and sand bottoms	Yes
Texas Pigtoe	*Fusconaia askewi*	SOC		Harris & Liberty	Rivers with mixed mud, sand, and fine gravel in protected areas	Yes
Wabash Pigtoe	*Fusconaia flava*	SOC		Harris & Liberty	Creeks to large rivers; mud, sand and gravel, not in deep shifting sands.	Yes
Creeper	*Strophitus undulatus*	SOC		Liberty	Small to large streams with gravel or gravel and mud substrates	Yes
Fawnsfoot	*Truncilla donaciformis*	SOC		Liberty	Small and large rivers with a variety of substrates and flow conditions	Yes

Table 4. State and Federal Listed Species Known to Occur in Liberty and Harris Counties *(continued)*

Common Name	Scientific Name	State Status[1]	Federal Status[2]	County of Occurrence	Habitat Description	Habitat Potentially Present
Texas Heelsplitter	*Potamilus amphichaenus*	SOC		Liberty	Quiet steams, rivers, and reservoirs with mud or sand substrates	Yes
Reptiles						
Alligator Snapping Turtle	*Macrochelys temminckii*	T		Harris & Liberty	Deep water of rivers and canals	Yes
Atlantic Hawksbill Sea Turtle	*Eretmochelys imbricata*	E		Harris	Gulf and bay system	No
Green Sea Turtle	*Chelonia mydas*	T		Harris	Gulf and bay system	No
Leatherback Sea Turtle	*Dermochelys coriacea*	E		Harris	Gulf and bay system	No
Loggerhead Sea Turtle	*Caretta caretta*	T		Harris	Gulf and bay system	No
Smooth Green Snake	*Liochlorophis vernalis*	T		Harris	Gulf coastal prairies, prefers dense vegetation	No
Texas Horned Lizard	*Phrynosoma cornutum*	T		Harris & Liberty	Open, semi-arid regions, with bunch grass	No
Timber/Canebrake Rattlesnake	*Crotalus horridus*	T		Harris & Liberty	Swamps/floodplains of hardwood/upland pine	Yes
Louisiana Pine Snake	*Pituophis ruthveni*	T		Liberty	Mixed deciduous/longleaf pine woodlands	No
Northern Scarlet Snake	*Cemophora coccinea*	T		Liberty	Mixed hardwood scrub on sandy soils	Yes
Vascular Plants						
Coastal Gay-feather	*Liatris bracteata*	SOC		Harris	Black clay soil of coastal prairie remnants	No
Houston Daisy	*Rayjacksonia aurea*	SOC		Harris	Seasonally wet, saline barren areas	No
Texas Meadow-rue	*Thalictrum texanum*	SOC		Harris	Mesic woodlands, partially shaded ditches	Yes
Texas Prairie Dawn	*Hymenoxys texana*	E	E	Harris	Poorly drained areas in open grasslands; pimple mounds	No
Texas Windmill-grass	*Chloris texensis*	SOC		Harris	Sand/sandy loam in open/barren grasslands	No
Threeflower Broomweed	*Thurovia triflora*	SOC		Harris	Black clay soil of remnant grasslands	No

Source: [1]TPWD 2006, [2] USFWS 2006
Notes: E = Endangered T = Threatened SOC = Species of Concern

The elements of occurrence listed by the NDD as occurring in the vicinity of Alternatives 2 and 3 are located adjacent to the Trinity River. The only state and/or federally-listed species identified by the NDD is the Bald Eagle (*Haliaeetus leucocephalus)*. In addition to listed species, the NDD also includes information on colonial waterbird rookeries, special vegetation communities, and migratory bird fallout areas. A rookery has been reported along the Trinity River and water/willow oak (*Quercus nigra/Quereus phellos*) dominated vegetational series are reported as also occurring in the vicinity of the Trinity River.

2.1.3 Sensitive or Critical Terrestrial and Aquatic Habitat

The Luce Bayou Interbasin Transfer project is located within the Austroriparian biotic province of East Texas. The Austroriparian province encompasses the Gulf coastal plain from extreme east Texas to the Atlantic Ocean. Typical vegetation types of this biotic province include longleaf pine (*Pinus palustris*) and loblolly pine (*Pinus taeda*) and hardwood forests variously consisting of sweetgum (*Liquidambar styraciflua*), post oak (*Quercus stellata*), and blackjack oak (*Quercus marilandica*). Lowland hardwood forests of this province are typically characterized by magnolia (*Magnolia grandiflora*), tupelo (*Nyssa sylvatica*), and water oak in addition to the trees mentioned above. According to TPWD's *Vegetation Types of Texas* (1984), portions of the alternatives nearest the Trinity River are listed as Willow Oak – Water Oak – Black Gum Forest. The remainder of the area within the alternative alignment is divided between cropland in the southern portion and pine-hardwood forest in the northern portion.

Vegetative habitats were analyzed using land cover data produced by the NOAA in 2001 (NLCD 2001). These data were created using 30-meter resolution Landsat Thematic Mapper and Landsat Enhanced Thematic Mapper satellite imagery. NOAA produced these data for the Coastal Change Analysis Program, a nationally standardized database of land cover information for coastal regions of the U.S.

These data show that 18 discrete land cover types are located along the alternative alignment. A list and description of the 18 discrete land covers are presented in *Table 5*. The distribution of land cover is shown on *Exhibit 9*. These land cover types acreages were quantified within the area of impact (i.e., within the 300-foot corridor centered on the each of the two alternative centerlines).

The most abundant land cover listed for the area of both project alternatives is palustrine forested wetlands. Both alternatives contain relatively small areas classified as developed, but Alternative 3 contains larger areas used for cultivated crops and pasture/hay. In addition to descriptions of each land cover, *Table 5* also lists the acres of each land cover type found within the area of impact.

Table 5. Land Cover Data for the Alternatives

Land Cover Type	Description	Alternatives (acres)	
		2	3
Developed, High Intensity	Highly developed areas where people reside or work in high numbers. Impervious surfaces account for 80 to 100 percent of the total cover.	0	0
Developed, Medium Intensity	Areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50 to 79 percent of the total cover.	0	0.03
Developed, Low Intensity	Areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 21 to 49 percent of total cover.	2.92	2.43
Developed, Open Space	Areas with some constructed materials but composed primarily of vegetation in the form of lawn grasses. Impervious surfaces account for less than 20 percent of total cover.	0.85	25.19
Cultivated Crops	Areas used for the production of annual crops. Crop vegetation accounts for greater than 20 percent of total vegetation. This class also includes all land being actively tilled.	0	68.71
Pasture/Hay	Untilled areas of grasses, legumes, or grass-legume mixtures planted for grazing or the production hay crops. Pasture/hay vegetation accounts for greater than 20 percent of total vegetation.	0.28	77.76
Grassland/ Herbaceous	Areas with 80 percent or greater herbaceous vegetation. These areas are not subject to intensive management such as tilling, but can be utilized for grazing.	38.57	34.61
Deciduous Forest	Areas dominated by trees generally greater than five meters tall and greater than 20 percent of total vegetation cover. More than 75 percent of trees shed foliage simultaneously	0.17	5.73
Evergreen Forest	Areas dominated by trees generally greater than five meters tall and greater than 20 percent of total vegetation cover. More than 75 percent of trees maintain their leaves year round	41.59	50.32
Mixed Forest	Areas dominated by trees generally greater than five meters tall, and greater than 20 percent of total vegetation cover. Neither deciduous nor evergreen trees are greater than 75 percent of total cover.	104.23	10.03
Scrub/Shrub	Areas dominated by shrubs less than five meters tall with shrub canopy typically greater than 20 percent of total vegetation. This class includes tree shrubs, young trees, or stunted trees.	19.7	45.98
Barren Land	Bare areas soil or rock. Vegetation accounts for less than 10 percent of total cover.	0.01	0.01
Palustrine Forested Wetland	Wetlands dominated by woody vegetation greater than or equal to 5 meters in height. Total vegetation coverage is greater than 20 percent.	857.25	511.36
Palustrine Scrub/ Shrub Wetland	Wetlands dominated by woody vegetation less than five meters in height. Total vegetation coverage is greater than 20 percent. Species present include true shrubs, young trees and stunted trees.	9.47	32.04
Palustrine Emergent Wetland (Persistent)	Wetlands dominated by persistent emergent vascular plants. Plants generally remain standing until the next growing season. Total vegetation cover is greater than 80 percent.	6.04	20.13
Unconsolidated Shore	Unconsolidated materials such as silt, sand, or gravel subject to inundation and redistribution due to the action of water.	1.54	2.40
Palustrine Aquatic Bed	Includes wetlands and deepwater habitats dominated by plants that grow and form a continuous cover principally on or at the surface of the water. Total vegetation cover is greater than 80 percent.	3.14	7.75
Open Water	All areas of open water, generally with less than 25 percent cover of vegetation or soil.	24.29	12.480
Total		1110.05	906.96

Source: National Land Cover Database (NLCD) 2001
Note: Areas were calculated using a 300-foot wide corridor centered on the project alternative centerline.

Resource agencies typically express interest in vegetation communities perceived as being especially rare, susceptible to disturbance, or ecologically valuable. One such community is mature, deciduous, riparian forest (bottomland hardwood forest). To quantify areas that are likely to contain deciduous riparian forest, areas classified by the NOAA land cover data as deciduous forest, mixed forest, and palustrine forested wetland within the FEMA 100-year floodplain were quantified. *Table 6* lists the estimated acreages of potential deciduous riparian forest within the 100-year floodplain and within the area of impact within the 300-foot corridor centered along each alternative. The Alternative 2 corridor contains 700.45 acres or 442 percent more land identified as deciduous riparian forest as compared to the Alternative 3 corridor.

Table 6. Areas of Deciduous Riparian Forest within the 100-Year Floodplain

NOAA Land Cover Type	**Area within 100-year Floodplain** (Acres)	
	Alternative 2	**Alternative 3**
Deciduous Forest	0.17	1.97
Mixed Forest	97.72	4.06
Palustrine Forested Wetland	602.56	123.28
Total	**700.45**	**129.30**

Source: NLCD 2001, FEMA 1995

2.1.4 Waters of the United States, Including Wetlands

As discussed in *Section 1.1.3*, waters of the United States, including wetlands, are protected under the Clean Water Act and the Rivers and Harbors Act and are regulated by USACE. The USACE is responsible for determining jurisdiction and issuing permits.

For this portion of the alternatives analysis, potential waters of the United States, including wetlands, were quantified using USFWS NWI maps, the USGS NHD, and FEMA floodplain maps (*Exhibit 10*). Additional data collection, field investigations, and environmental and engineering data analyses were conducted to demonstrate that impacts to wetlands and other jurisdictional waters of the United States would be avoided to the extent practicable, minimized to the extent appropriate and practicable, and that compensatory mitigation for unavoidable adverse impacts would offset the loss of wetland functions and values to the extent appropriate and practicable.

Alternative 2 would be partially constructed within a jurisdictional waterbody, Luce Bayou, thereby intersecting only one waterbody. Alternative 3 would intersect a greater number of drainage or canal crossings (5) because it would traverse an agricultural area serviced by irrigation canals. Alternative 2 may impact approximately 122,640 linear feet (23.2 miles) of Luce Bayou and associated tributaries, while Alternative 3 may impact approximately 38,520 linear feet (7.3 miles) of waterbodies, which includes natural and constructed drainage ways.

The acreage of NWI wetlands within a 300-foot area of impact was calculated to determine potential wetland impacts. To quantify the acreage of potential USACE jurisdictional wetlands within the candidate alternatives, only the NWI wetlands located within the 100-year floodplain were included in the acreage calculation. Alternative 2 has a greater amount of NWI wetlands within its corridor. A greater percentage of Alternative 2 also lies within the 100-year floodplain; therefore, a greater percentage of the NWI wetlands along Alternative 2 could potentially be considered jurisdictional by the USACE. A map of NWI wetlands along the alternatives is presented in *Exhibit 10*. *Table 7* presents the acreage of NWI wetlands, NWI wetlands within the 100-year floodplain, and the linear feet of waterbodies impacted by each alternative.

Table 7. Wetlands and Waters of the United States

	Alternative Two	Alternative Three
NHD Dataset		
Number of waterbody crossings using NHD dataset	1	5
Linear feet of stream affected using NHD dataset	122,640 feet	38,520 feet
NWI Wetlands		
NWI Wetlands	234.39	232.38
NWI Wetlands classified by NLCD as a cultivated field	0	22.62
NWI Wetlands Within the 100-year Floodplain	212.63	59.77
NWI Wetlands within the 100-year floodplain and not a cultivated field	212.63	59.77

Source: NWI 1991, NHD 2006

A small check dam is located within the Luce Bayou channel downstream of the confluence of Tarkington Bayou with Luce Bayou. The dam was constructed to create a small impoundment within the channel to facilitate the pumping of water from Luce Bayou into Reidland reservoir on the south side of the bayou. The impounded water within the reservoir is distributed through a system of irrigation channels, primarily for rice cultivation. The reservoir remains in active use for agricultural irrigation.

Alternative 2 would increase flow volumes and velocities within Luce Bayou. Flow dynamics over the dam would be altered, potentially destabilizing the banks in the area of the dam. Removal or modification of the dam structure may be required to accommodate the changed flow characteristics. Activities associated with removal or modification of the dam would be expected to involve work within the jurisdictional channel of Luce Bayou, thereby requiring coordination with the USACE for permit authorization to conduct the necessary work activities.

Similarly, activities associated with construction of an intake structure and pump station at the Trinity River would be expected to involve work within the river channel. Coordination with the USACE would also be required for permit authorization to conduct the necessary work within this navigable water of the United States.

2.1.5 Public Parks, Recreational Areas, and Wildlife Management Areas

Public parks, recreation areas, and wildlife management areas were obtained from sources including LCAD, HCAD, USGS topographic maps, the TXGLO, and the USFWS. TCB met with USFWS personnel and received information on the USFWS plans for acquisition of a future wildlife corridor that would connect to the existing USFWS-managed Trinity River NWR and habitat along the Trinity River. The proposed wildlife corridor would surround the existing TRPS and the proposed Capers Ridge Pump Station. *Exhibit 3* shows land currently owned by USFWS and land planned for future acquisition.

The majority of the area along the alternatives is undeveloped land or land currently used for residential, agricultural, commercial, and mixed land uses. Two park-like areas were identified in the

vicinity or along the areas of Alternatives 2 and 3. A portion of the Trinity River NWR is located approximately 0.8-mile north of the proposed Capers Ridge Pump Station and Alternatives 2 and 3 (*Exhibit 3*). A 10,150-foot section of Alternatives 2 and 3 are part of a land acquisition plan by the USFWS. The USFWS plan includes acquiring floodplain areas within a corridor identified along the Trinity River for conservation as part of the Lower Trinity River Floodplain Habitat Stewardship Program. These lands would be acquired as funding becomes available. However, no funding is currently available and if funding becomes available this land could be purchased in the future.

The second park-like facility identified within the boundaries of Alternatives 2 and 3 is the Lake Houston Golf Course. The Lake Houston Golf Course is a privately owned 18-hole golf course located at 27350 Afton Way in Huffman, Texas. The golf course is open to the public for golf, or a membership can be obtained. The aerial photography shows that several residential homes surround portions of the golf course. The current alignment of Alternative 3 bisects the golf course. Alternative 2 follows the western boundary of the golf course (*Exhibit 11*).

2.1.6 Surface Water Quality and Floodplains

Luce Bayou and Lake Houston are the primary surface waters potentially affected by Alternatives 2 and 3. Luce Bayou is estimated to contribute approximately 10 percent of the flows entering Lake Houston from the major tributary systems that supply water to the lake. Development within the Luce Bayou watershed is minimal, thereby limiting the potential introduction of pollutants into the bayou that could degrade water quality. The identification of floodplains associated with the Trinity River and Luce Bayou is used to determine if portions of the project would occur within a mapped floodplain. Project activities would need to incorporate floodplain protection requirements mandated by federal laws and local floodplain management ordinances.

2.1.6.1 Surface Water Quality

The TCEQ routinely monitors surface water quality in the state. Water quality results for all monitored stream segments are reported in the TCEQ's "The State of Texas Water Quality Inventory." Sources for the data include the TCEQ Surface Water Quality Monitoring Program fixed-station network, the USGS Texas Water Quality Monitoring Network, and data contributed through the Clean Rivers Program from cities, river authorities, and other local entities. Luce Bayou (Segment ID 1002B) is a freshwater stream that fully supports aquatic life and contact recreation uses; fish consumption use was not assessed. Concern for aquatic life use was identified because of depressed dissolved oxygen. Lake Houston (Segment ID 1002) is a 12,240-acre reservoir fully supporting aquatic life, contact recreation, public water supply, fish consumption, and general uses.

A study was conducted by Espey Consultants (2006) to assess the potential effects to water quality in Lake Houston from the transfer of water from the Trinity River basin to the San Jacinto River basin. The conclusions of the investigation were that the diversion of Trinity River water would have some beneficial effect on the water quality of Lake Houston, and even though the diversion of Trinity River water would increase nutrient loading in Lake Houston, the additional flow and nutrient loading would not be expected to degrade the overall water quality. The anticipated improvement to Lake Houston water quality would not be significant because the full amount of water transfer associated with the project (400 MGD) would represent only 23 percent of the total inflow into Lake Houston.

2.1.6.1.1 Aquatic Health

During 1997-98, the USGS, in cooperation with the Houston-Galveston Area Council (HGAC) and the TCEQ (formally Texas Natural Resource Conservation Commission), under the authorization of the Texas Clean Rivers Act, conducted an investigation to assess the status of in-stream biological resources, including fish and macrobenthic community structure and physical stream habitat conditions.

Luce Bayou at Station ID Luce 1280 was selected as a reference site for the investigation. Numerous fish species were sampled from the Luce Bayou station, including pickerels, shiner, and sunfish. The Ephemeroptera (mayflies) – Plecoptera (stoneflies) –Trichoptera (caddisflies) (EPT) taxa richness was also calculated. Because these species are sensitive to water quality, the EPT taxa richness is a measure of stream water quality. The EPT taxa richness for the Luce Bayou station is 6.0, with 76 percent of the sampled taxa being EPT taxa. High numbers of these species within the population indicates better water quality.

2.1.6.2 Floodplains

Information relative to floodways and floodplains was obtained from the FEMA. Digital files of the FEMA-mapped flood hazard areas were overlain on electronic project files to identify areas of the project that are coincidental with mapped flood hazard areas. Mapped flood hazard areas are presented in *Exhibit 10*.

The floodway and 100-year floodplain associated with the Trinity River and Luce Bayou, as mapped by the FEMA, are presented in *Exhibit 10.* As shown on *Exhibit 10,* portions of the Trinity River 100-year floodplain in the region of the project are several miles wide. The 100-year floodplain of Luce Bayou, which is a smaller watercourse than the Trinity River, is confined to a relatively narrow area that includes the main channel of Luce Bayou and smaller tributary channels draining into the bayou. The exception is the upstream portion of the Luce Bayou watershed between SH 321 and FM 1008, where the 100-year floodplain is noticeably wider than the downstream.

Total area of Alternatives 2 and 3 within the floodplain is 120,200 linear feet and 23,200 linear feet, respectively. Work within the Trinity River floodplain is expected to occur with the construction of the Capers Ridge Pump Station; however, Capers Ridge is above the 100-year floodplain elevation and, as such, the majority of the pipeline alignment would be unencumbered by constraints associated with the mapped Trinity River 100-year floodplain. The canal section of Alternative 2 that connects the pipeline to the Luce Bayou channel near SH 321 is primarily located within the mapped 100-year floodplain of Luce Bayou.

Alternative 2 would convey water from the Trinity River through the Luce Bayou channel beginning near SH 321. The remainder of the channel extending to Lake Houston is within the mapped 100-year floodplain. Hydrologic modeling of the increased flows within Luce Bayou relative to storm event flows may be necessary to determine if the extent of the 100-year floodplain would be altered by the diversion of Trinity River water through the existing Luce Bayou channel. If channel improvements or reconfiguration of the channel is needed to convey the anticipated flows, modeling would be necessary to determine how the channel improvements/reconfiguration would affect the 100-year floodplain.

Alternative 3 would convey Trinity River water through a canal that would diverge southward from the Luce Bayou channel near SH 321. The majority of the canal would be situated outside the mapped 100-year floodplain of Luce Bayou. The alignment of Alternative 3 would be refined to avoid and minimize impacts to the floodplain. The exception would be the upstream portion where the canal diverges from the bayou channel near SH 321 (approximately 3,375 linear feet), and the downstream portion where the canal merges with the bayou channel (approximately 9,750 linear feet). Hydrologic modeling would be needed to determine if the diverted Trinity River water would affect the 100-year floodplain of Luce Bayou downstream of the point where the diverted water enters the bayou.

Both alternatives would involve some construction within the mapped 100-year floodplain. Alternative 2 would have the greater potential to alter the mapped floodplain of Luce Bayou, as the bayou channel would be the primary route for conveying the diverted water. Alternative 3, being situated primarily outside the mapped floodplain of Luce Bayou, may affect only the lower portion of the bayou, downstream of the confluence of the canal and Luce Bayou. Project planning for either

alternative would need to accommodate regulations, policies, and guidelines for construction within floodplains and potential changes to area hydrology, drainage, and local geomorphology.

2.1.7 Cultural and Archaeological Resources

Past cultural resources survey reports were reviewed to identify cultural resources in the area of Alternatives 2 and 3 (Chaffin-Lohse 1978, Moore and Heartfield 1982). These studies were performed previously for the Luce Bayou project. In addition, the online Texas Historical Commission (THC) Atlas was reviewed to assess the location of historical markers, National Register of Historic Places properties, national register district, and/or cemeteries. GIS shapefiles were also obtained from THC and the files were reviewed to determine whether mapped cultural or archeological resources were present in the vicinity of Alternatives 2 and 3. Based on this review of THC files, no previously recorded historic places or archeological resources were identified in the vicinity of Alternatives 2 and 3.

Six archaeological sites containing archaeological artifacts such as historic ceramics, glass, wire, and metal fragments were identified based on the work performed in 1978 (Chaffin-Lohse 1978). Three of the sites were disturbed prior to the 1978 investigation. No further work was recommended for these sites. Two of the sites were recommended to be avoided. The alignment of the Luce Bayou project at the time of the 1978 study avoided the site. One site was recommended for further excavations. This site, 41-LB-41, was investigated further in 1981 and 1982 (Moore and Heartfield 1982). This study concluded that the site should not be considered significant, and was not eligible as a State Archaeological Landmark (SAL) status or for inclusion on the National Register of Historic Places. Most of the site had already been destroyed by normal erosional processes. The site is situated at the Capers Ridge Pump Station location. Either alternative, Alternative 2 or Alternative 3, would require the construction of the pump station. In accordance with the National Historic Preservation Act of 1966 (as amended) and other laws and regulations, it is recommended that detailed site investigations be conducted to identify potential project impacts to cultural resources and to further refine the location of the alternatives.

2.1.8 Environmental Justice and Socioeconomics

Environmental justice and socioeconomic analyses for Alternatives 2 and 3 were calculated as part of Section 1.1.4. *Tables 1* and *2* provide information on the environmental justice and socioeconomic criteria.

2.1.8.1 Socioeconomic Resources

Race, poverty level, and median income were the socioeconomic criteria evaluated for the two project alternatives. One census tract, Census Tract 7009 in Liberty County, exhibited a minority population greater than 50 percent of the total population. Alternatives 2 and 3 crossed this census tract for approximately 74,300 feet and 61,300 feet, respectively. All populations within the census tracts that are intersected by Alternatives 2 and 3 have incomes that are above the poverty level and have higher median incomes compared with the median incomes exhibited by county, state, and national populations.

Within Liberty County, Census Tracts 7003 and 7009 exhibit higher percentages of LEP and LI populations than the county average, but are lower than the state and national average. Census Tract 2517 in Harris County has a higher percentage population that is LEP. Both tracts in Harris County have a higher percentage population that are LI than the county level, but lower than the state and national level. Future public information/involvement should consider LEP and LI population.

2.1.9 Potential Dislocations

Potential dislocation, partial dislocation or disruption of parcels, structures, utility/pipeline easements and fence lines for Alternatives 2 and 3 were evaluated. Dislocation counts were based on review of aerial photographs (TXGLO Landsat 2003, H-GAC 2006 and 2004), and LCAD and HCAD property records.

Potential residential, farming, agricultural, and other dislocations or relocations for Alternatives 2 and 3 are listed in *Table 8* and depicted on *Exhibit 11*. The total number of land parcels that would be impacted by property acquisition for Alternatives 2 and 3 would total 36 and 47, respectively. As discussed in Section 2.1.1, Alternatives 2 and 3 would impact agricultural areas or farming operations. These agricultural areas or farms could be isolated or impacted by the water canal because it could divide the existing property or land parcel. During property acquisition of property/parcels, access or related dislocation issues could include hydrologic concerns, access issues at water crossings, or restriction of access of farm equipment to agricultural land. Alternative 3 would bisect the Lake Houston Golf Course.

Table 8. Potential Dislocations Along Alternatives Corridors 2 and 3

Number	Alternative 2	Alternative 3	Description of Dislocations
1	Y	Y	Roadway crossing
2	Y	Y	Roadway crossing
3	Y	Y	Roadway crossing
4	Y	Y	Fence crossing
5	Y	Y	Roadway crossing
6	Y	Y	Magnolia Pipeline easement
7	Y	Y	Roadway or fence crossing
8	Y	Y	Road crossing
9		Y	Fence line
10		Y	Fence line crossing
11		Y	Fence line/ utility crossing
12		Y	Fence line crossing
13		Y	Agricultural canal and possible fence crossing
14		Y	Agricultural canal crossing
15		Y	Agricultural canal crossing
16		Y	Pond or wetland complex
17		Y	Fence line easement along pond/ wetland complex
18		Y	Fence line/canal easement
19		Y	Fence line
20		Y	Fence/utility line
21		Y	Fence crossing
22		Y	Fence crossing

Table 8. Potential Dislocations Along Alternatives Corridors 2 and 3 *(continued)*

Number	Alternative 2	Alternative 3	Description of Dislocations
23		Y	Fence crossing
24		Y	Fence crossing
25		Y	Electrical utility crossing
26		Y	Utility crossing
27		Y	Utility crossing
28		Y	Fence line crossing
29		Y	Fence line crossing
30		Y	Bridge
31		Y	Electrical utility crossing
32		Y	Residential home
33		Y	Residential home and pool
34		Y	Residential home
35		Y	Barn/garage on residential property
36		Y	Possible residential structure
37	Y		Pump at Reidland Reservoir
38	Y		Reidland Dam
39	Y		Amoco pipeline crossing
40	Y		Bridge

Note: Locations of dislocations were estimated based on aerial photographic review and interpretation.

2.1.10 Oil and Gas Wells

Oil and gas location maps were obtained from a private vendor, GeoMap® Inc., and publicly available oil and gas records issued by the RCC were also obtained and reviewed. In general, salt domes and the associated faulting are sources of oil and gas accumulation and production in the vicinity of Alternatives 2 and 3.

In Liberty County, prospecting for oil began about 1901, chiefly in the southern part of the county. Daisetta and Hull became oil towns after a nearby field was discovered in 1918. Wells were established at the Old River Lake Field by 1904. Other wells were drilled and were productive at the North Dayton, Esperson Dome, Moss Bluff, Davis Hill, and South Liberty Fields in 1925 and at the Hankamer Field in 1929. By 1990, oilfields in Liberty County had cumulatively produced almost 496 million barrels of oil, as well as significant amounts of natural gas. North Dayton Field is located approximately 1.5 to 4 miles south of Alternatives 2 and 3.

One dry hole in the Jno R. Rhea Survey, A-62, is located north at and approximately 500 feet away from the centerline of Alternative 2 in the vicinity of the confluence of Luce Bayou with Lake Houston. This well, the Southern Minerals #1 May, was drilled in 1948 and reached a total depth of 8,865 feet (GeoMap® 2005).

Petroleum exploration has occurred throughout the vicinity of Alternatives 2 and 3. Drilled or abandoned wells and related facilities may be present in the vicinity of Alternatives 2 and 3. As such, it is recommended that detailed site investigations be conducted to identify potential project impacts related to historic and present-day oil and gas exploration and to further refine the location and alignment of Alternatives 2 and 3.

2.1.11 Pipelines

Twenty pipelines intersect Alternatives 2 and 3. These pipelines are located in 12 to 14 pipeline corridors and, in general, area pipelines provide service to area oil and gas fields. From south to north, pipelines owned by the following operators intersect the alternatives and contain a variety of hydrocarbons including natural gas liquids, natural gas, propylene, propane, crude oil, natural gas liquids, liquefied petroleum gas, and ethylene.

- TEPPCO Crude Pipeline, LLC
- Kinder Morgan Texas Pipeline, LP
- Mustang Pipeline Company
- Valero Logistics Operations, L.P.
- Kinder Morgan Texas Pipeline, LP
- Black Hills Operating Company LLC
- BP Pipeline (North America Inc)
- Transcontinental Gas Pipeline Company
- Natural Gas Pipeline Company of America
- KOCH Pipeline Company LP
- Chevron Pipeline Company
- Texas Eastern Products Pipeline Company LP

Based on limited field investigations, the inspected pipeline right-of-way appeared mowed and well-maintained; there were no obvious signs of releases or leaks associated with area pipelines. However, there are numerous pipeline corridors that intersect Alternatives 2 and 3. There is the potential for abandoned or inactive pipelines to be present. As such, it is recommended that detailed site investigations be conducted to identify potential project impacts related to pipelines and to further refine the location and alignment of Alternatives 2 and 3.

2.1.12 Hazardous Materials and Regulated Facilities

Available hazardous waste and regulated facility records from the EPA and TCEQ websites were obtained as well as the Closed Municipal Solid Waste Landfill Inventory (CMSWLI) maintained by the HGAC. These records were reviewed to determine whether regulated facilities are present within 500 feet of the centerline of Alternatives 2 and 3. No hazardous waste, hazardous materials handling, or closed municipal landfill inventory sites are present within 500 feet of the centerline of Alternatives 2 and 3 based on the records review conducted. However, during development of the preferred alternative alignment, the location of hazardous waste and hazardous materials handling and permitted facilities should be identified. Regulatory databases and records such as those identified below should be collected and reviewed.

- Emergency Response Notification System (ERNS), U.S. EPA database of emergency response actions for reported spills of regulated materials
- RCRA Small Quantity Generators database, the U.S. EPA database of sites that create hazardous waste or meet other RCRA small quantity generator requirements
- No Further Remedial Action Planned (NFRAP), U.S. EPA database of Comprehensive Environmental Response, Compensation, and Liability Act sites where contamination was removed quickly or was not considered serious
- Texas Industrial Hazardous Waste Notice of Registration (IHWNOR) database, includes sites listed in the TCEQ Texas Hazardous Waste Notice of Registration database
- Leaking Petroleum Storage Tanks (LPST), TCEQ database of underground storage tanks that have reported leaks of petroleum substances
- Registered Petroleum Storage Tanks (PST), TCEQ database of underground storage tanks that are registered with the state
- State Sites comprising three databases from the TCEQ for (1) state Superfund sites, (2) voluntary cleanup program sites, and (3) the innocent owner/operator program

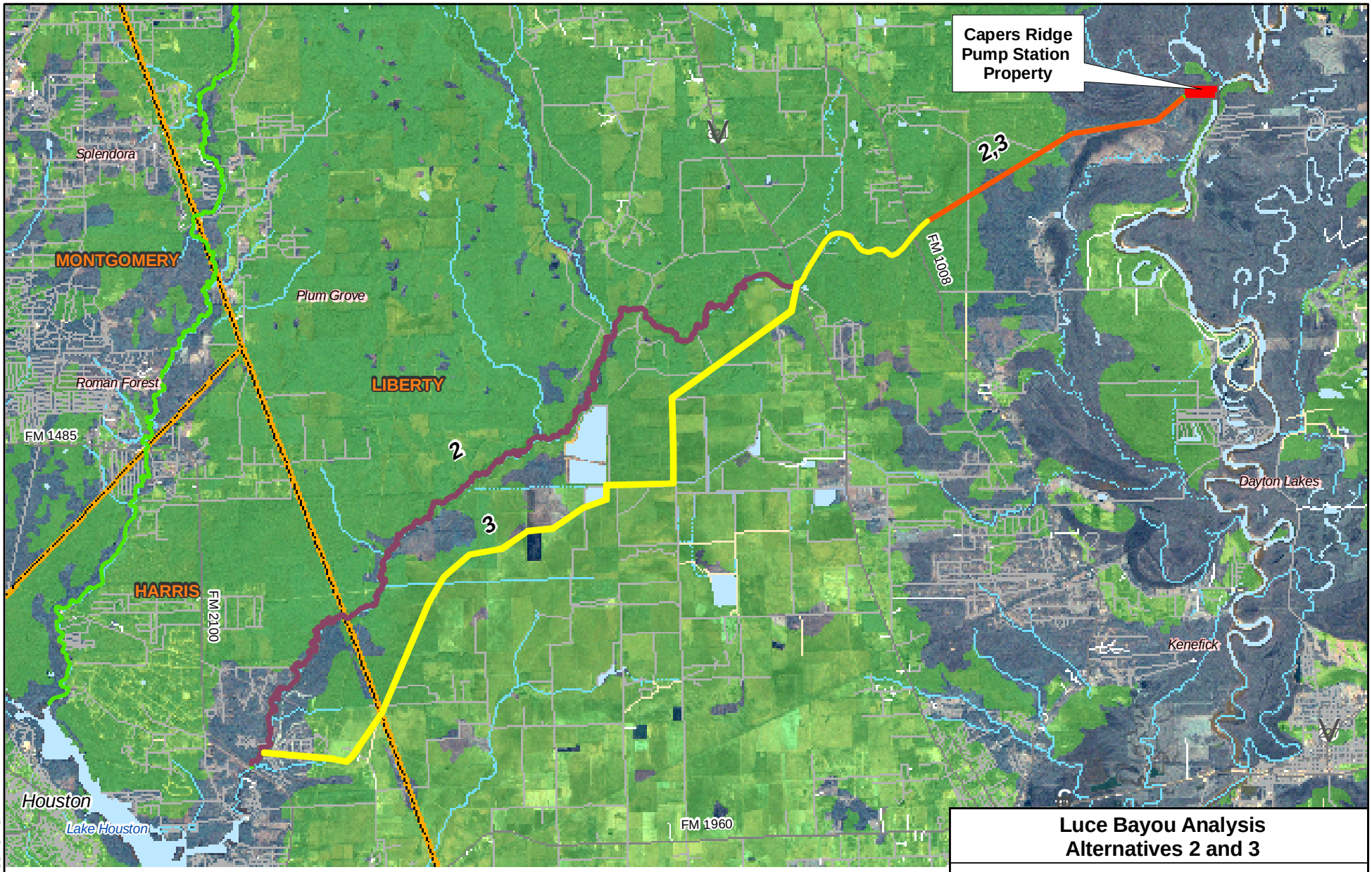
In addition, prior to property acquisition, it is recommended that a Phase I Environmental Site Assessment be conducted in accordance with *American Society for Testing and Materials (ASTM) Standard: E 1527-06 Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process*. The purpose of a Phase I Environmental Site Assessment would be to investigate recognized environmental conditions that may be associated with the property under investigation. Recognized environmental conditions would be identified based on a review of past and present land uses and the current conditions of the subject property in order to identify the presence of hazardous substances or petroleum products that may impact the property. The term "recognized environmental conditions" means the presence or likely presence of hazardous substances or petroleum products at a property. The term is not intended to include *de minimis* environmental conditions that generally do not present a material risk to public health or the environment.

2.1.13 Mitigation Options

USACE wetland permits often require compensatory mitigation for lost functions and values of wetlands affected by the project. A compensatory mitigation plan would likely be required by the USACE as part of the Section 404 permit review process, and the execution of the approved mitigation plan would become a condition of the Section 404 permit. Mitigation requirements could be satisfied in a variety of ways including wetlands preservation through the establishment of conservation easements, purchase of wetlands credits at an established mitigation bank, enhancement and/or restoration of existing wetlands, and construction of new wetlands. The approved mitigation plan would provide a detailed discussion of mitigation commitments for unavoidable impacts to jurisdictional waters of the United States. Viable mitigation options should be investigated and discussed with USACE and resource agencies during project planning. Mitigation options may include on-site mitigation and off-site mitigation. Viable wetland mitigation alternatives should be investigated and evaluated in the mitigation plan.

On-site mitigation may include creation or enhancement of wetlands within the project right-of-way, which would primarily involve development of wetlands similar in function and value to the wetlands affected during construction. On-site mitigation may not be adequate for replacement of all lost wetland functions and values; it may be considered as a supplement to off-site mitigation.

Further coordination with the USACE and resource agencies may result in the elimination of on-site mitigation as an option, especially if off-site mitigation options more adequately compensate for effects to wetland functions and values. Potential off-site areas that could be considered for enhancement, restoration, and/or preservation include tracts of land within and adjacent to Luce Bayou, San Jacinto River, or Trinity River floodplains that may be placed under conservation easement or purchased and placed under perpetual deed restriction. Other options may include the purchase of credits from approved wetlands mitigation banks, in-lieu-fee arrangements, wetland creation, or enhancement of property currently owned and/or managed by resource agencies, Harris County, or Liberty County. Offsite wetland mitigation options could include restoration of uplands surrounding wetland habitat and/or preservation efforts to ensure sufficient hydrology for constructed or acquired wetland habitat. Use of a quantitative model may be required to assess the functions and values of affected wetlands and waters of the United States.



Source - Imagery from Texas General Land Office (Landsat 2003)

Legend

- County Line
- Prime Farmland
- Canal
- Existing Natural Channel
- Pipeline

0 12,000 Feet

Luce Bayou Analysis Alternatives 2 and 3

Prime Farmland Soils

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Exhibit	Job No.	Date
7	60018609	January 2007

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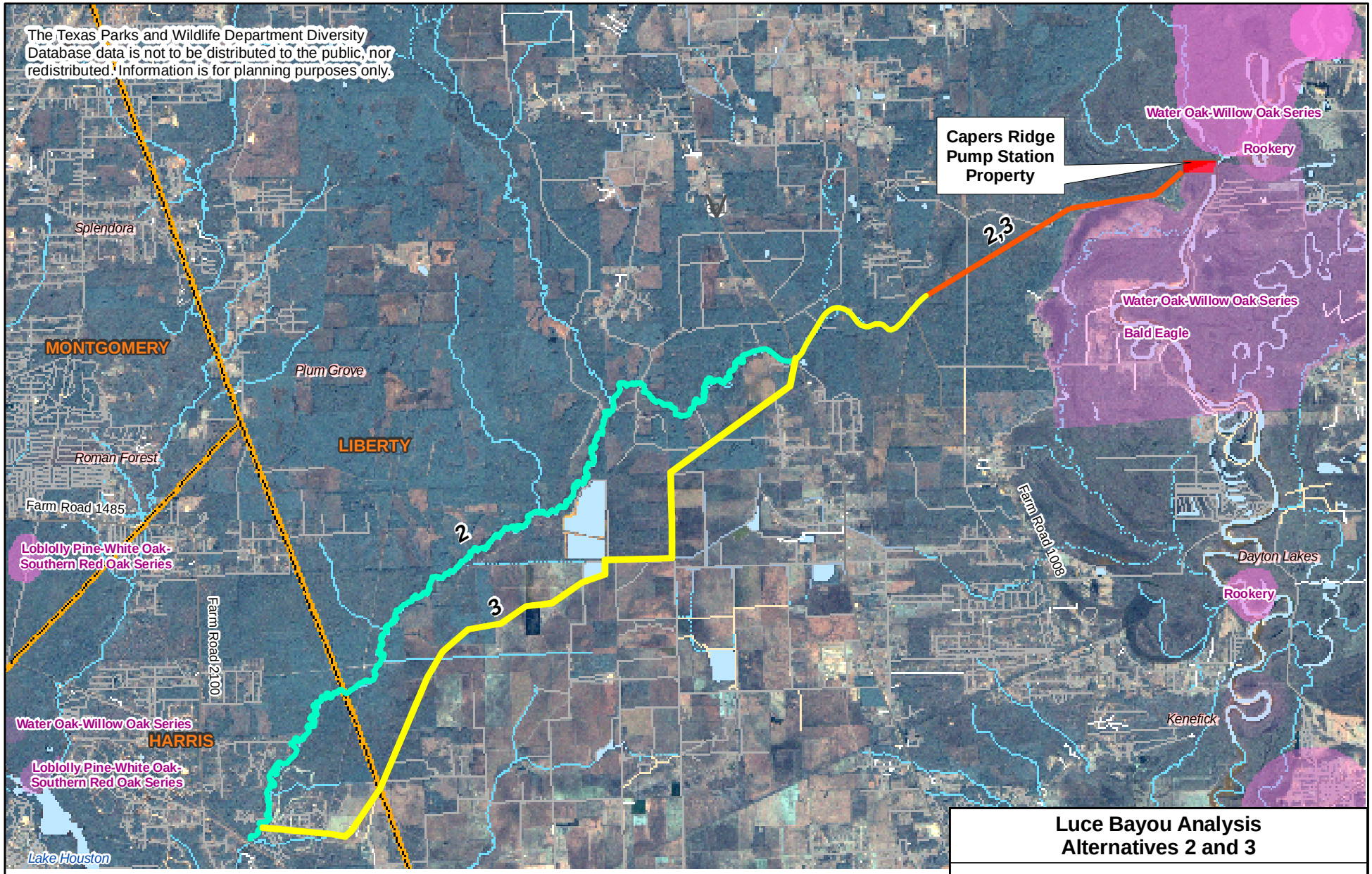

Source - Imagery from Texas General Land Office (Landsat 2003)

0 12,000 Feet

Legend

- County Line
- TPWD Natural Diversity Data
- Canal
- Existing Natural Channel
- Pipeline

Luce Bayou Analysis Alternatives 2 and 3

TPWD Natural Diversity Data

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Exhibit	Job No.	Date
8	60018609	January 2007

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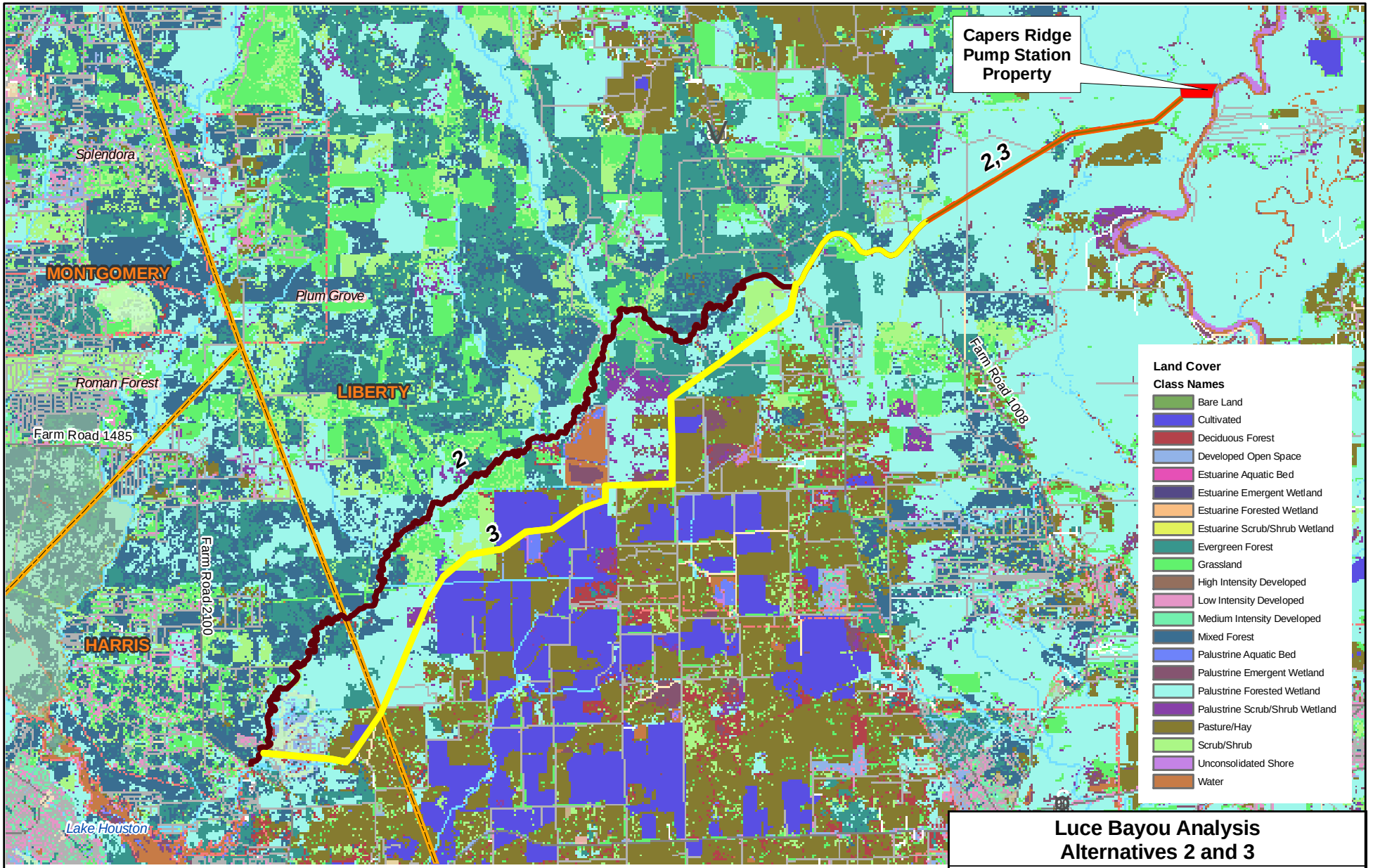

Source - Land Cover Data: NLCD(2001)

Legend

County Boundary
Existing Natural Channel
Canal
Pipeline

0 12,000 Feet

Luce Bayou Analysis Alternatives 2 and 3

Land Cover Data

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Exhibit	Job No.	Date
9	60018609	January 2007

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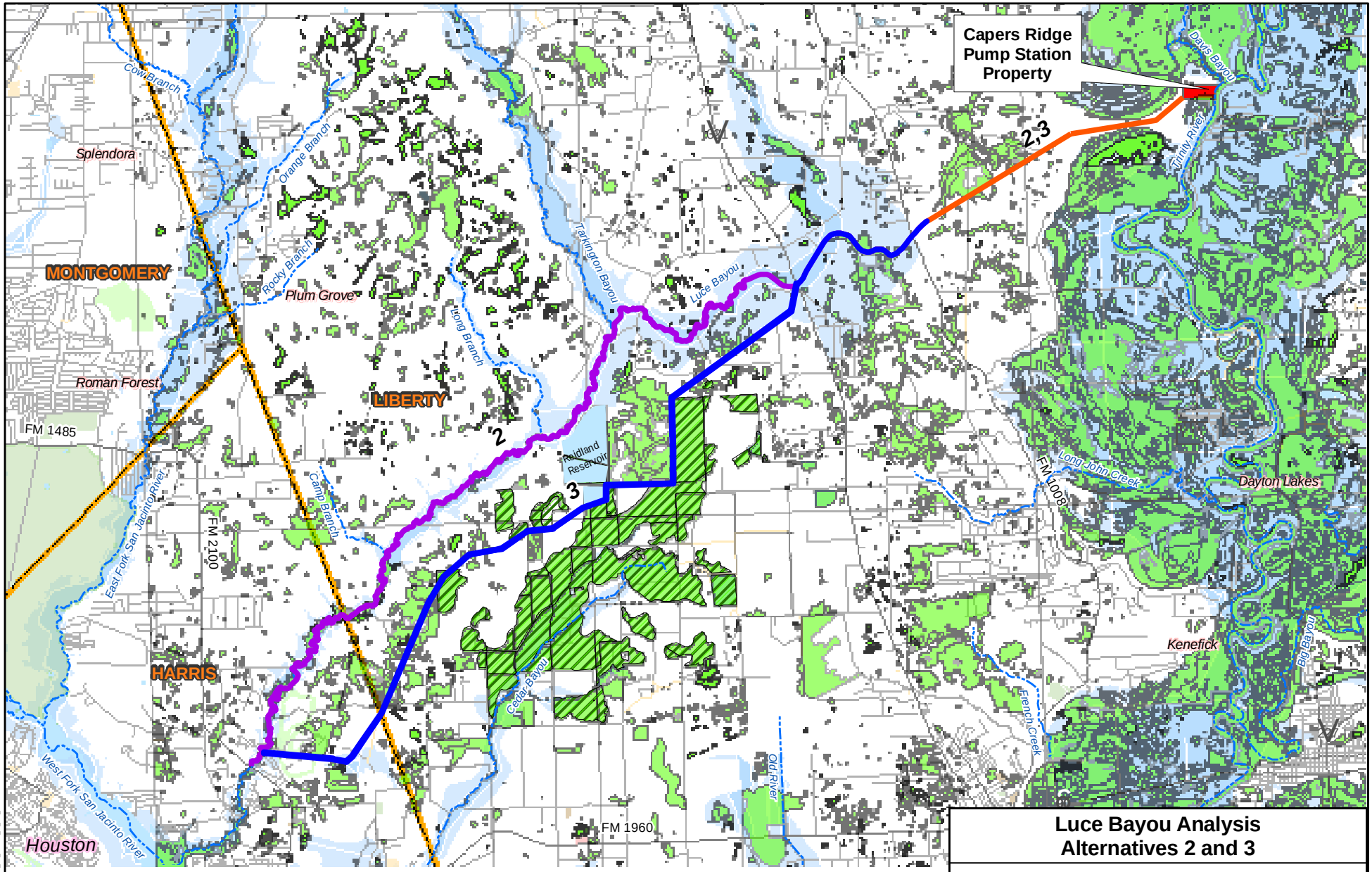

Source - Imagery from Texas General Land Office (Landsat 2003)
NWI Wetlands: USFWS
Floodplain: FEMA (2000) and TSARP (2006)
TSARP floodplain data is only available for Harris County.

Note: Based upon limited field observation, NWI wetlands mapped within active agricultural fields may not exhibit the mandatory parameters of jurisdictional wetlands.

0 12,000 Feet

Legend

- Canal
- Existing Natural Channel
- Pipeline
- 100-Year Floodplain
- 500-Year Floodplain
- NWI Wetlands
- NWI Wetlands in Active Agricultural Areas (see note)

Luce Bayou Analysis Alternatives 2 and 3

Waters of the United States, including NWI mapped Wetlands

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Exhibit	Job No.	Date
10	60018609	January 2007

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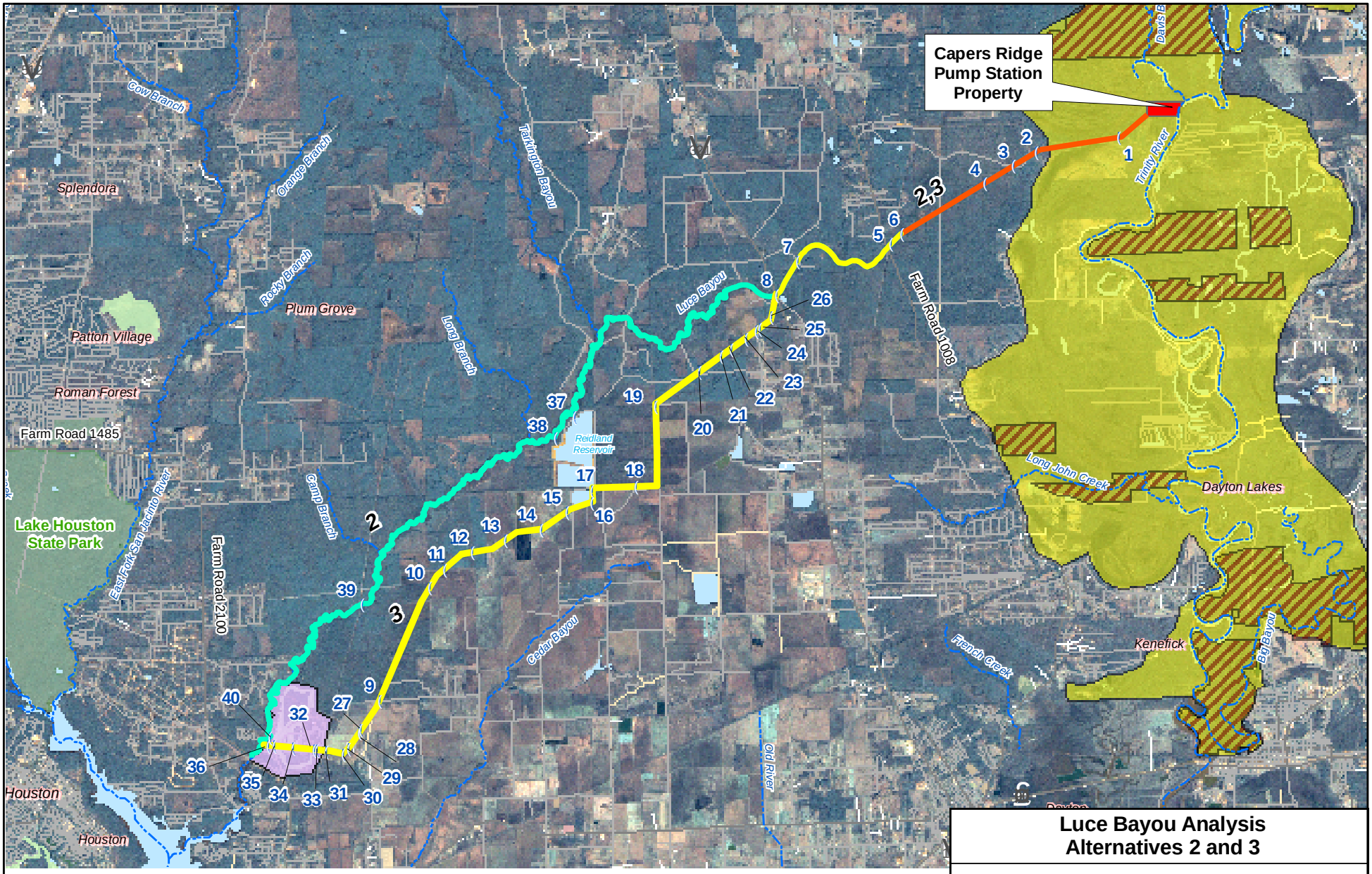

Source - Imagery from Texas General Land Office (Landsat 2003)

Legend

- Potential Dislocation (No.)
- Named Streams and Rivers
- Canal
- Existing Natural Channel
- Pipeline
- State Natural Area
- State Park
- USFWS Proposed Acquisition Corridor
- USFWS Trinity River National Wildlife Refuge Property
- Lake Houston Golf Course

0 12,000 Feet

Luce Bayou Analysis Alternatives 2 and 3

Potential Dislocations

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Exhibit	Job No.	Date
11	60018609	January 2007

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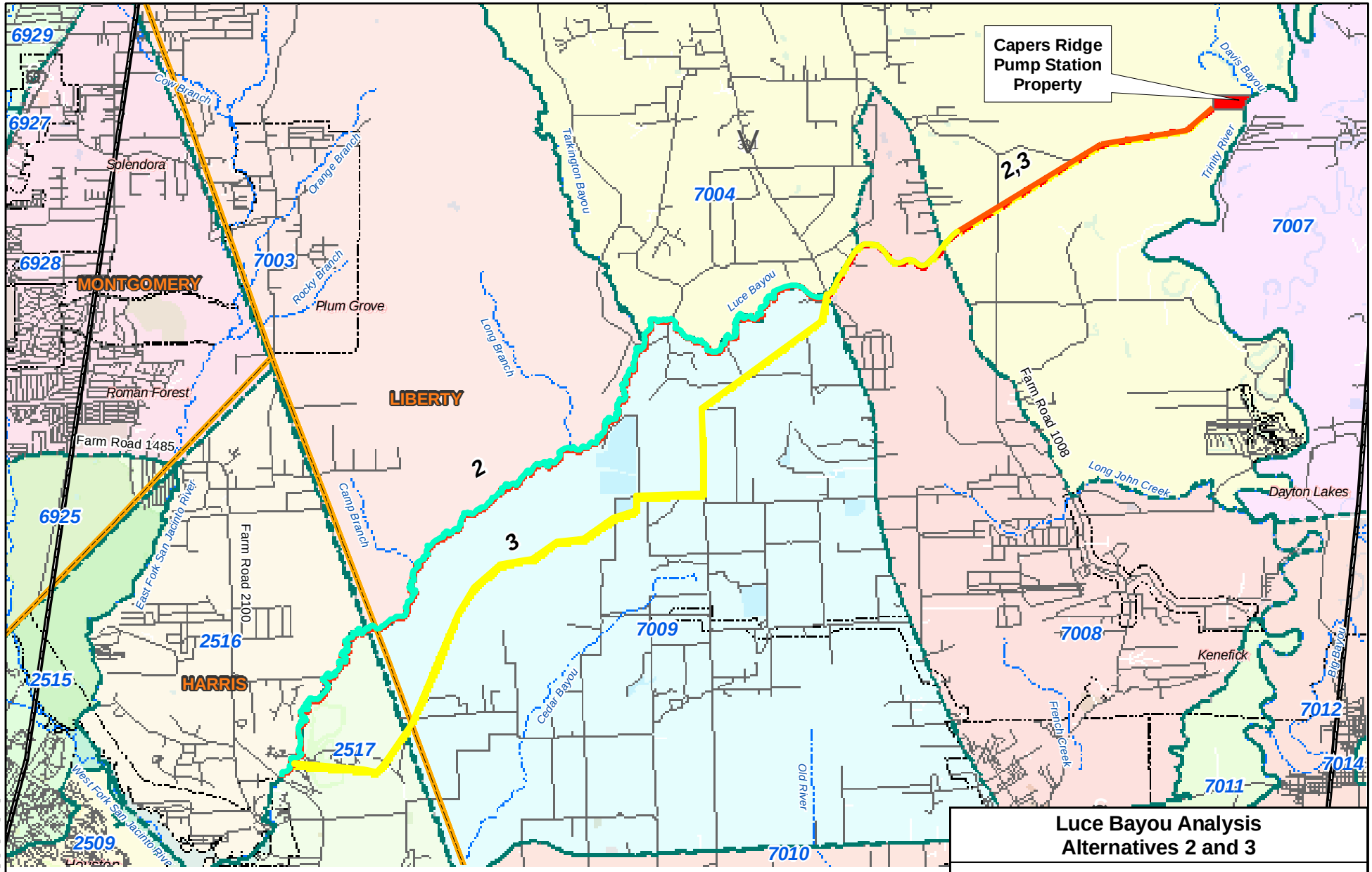

Source - US Census Bureau (2000)

Legend

- Study Area
- County Boundary
- City Limit
- 0000 CensusTracts with Numbers
- Canal
- Existing Natural Channel
- Pipeline
- Named Streams and Rivers

0 12,000 Feet

Luce Bayou Analysis Alternatives 2 and 3

Environmental Justice and Socioeconomics

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Exhibit	Job No.	Date
12	60018609	January 2007

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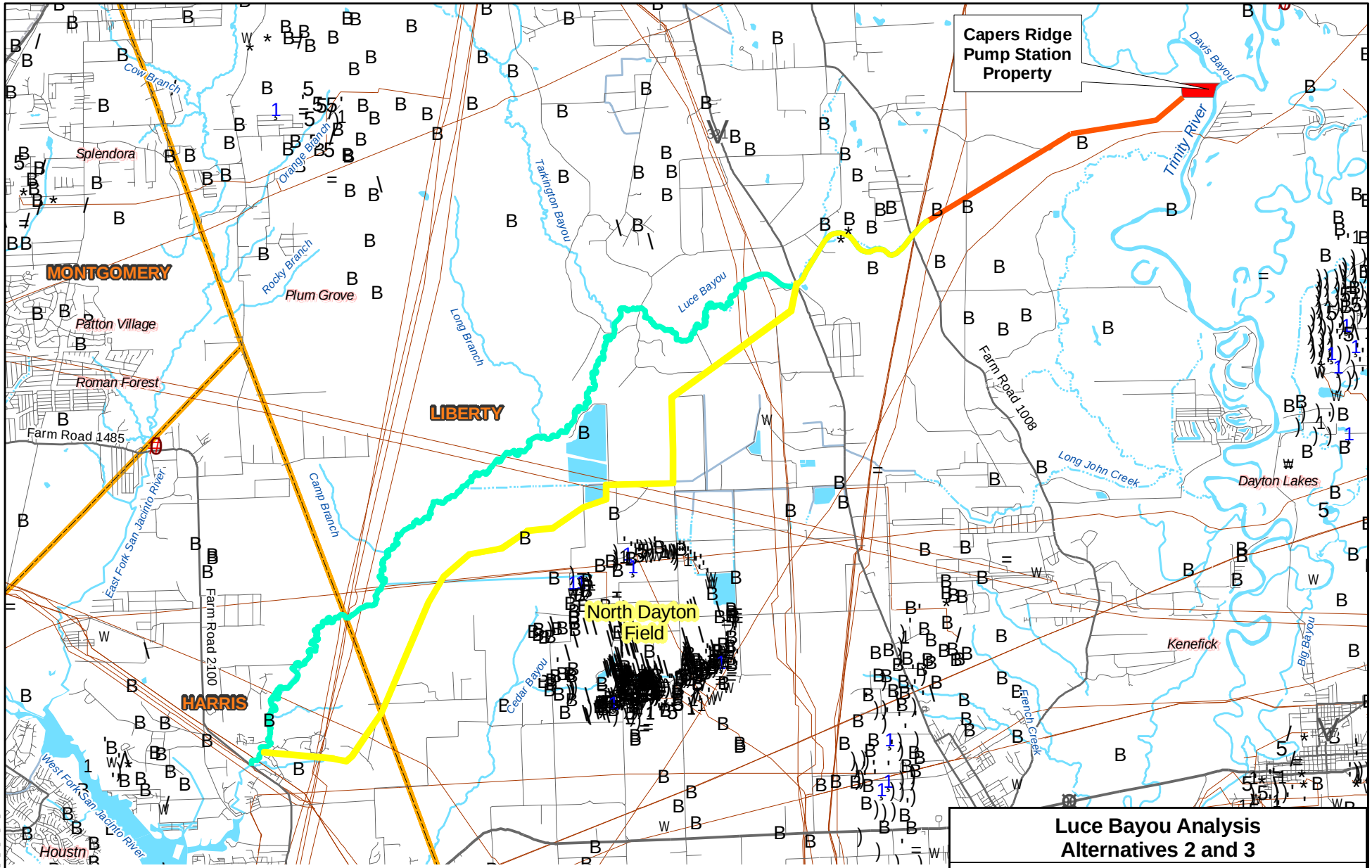

Source - Wells and Pipelines from Railroad Commision of Texas (2006)

Legend

- County Line
- Pipelines
- Landfills
- Canal
- Existing Natural Channel
- Pipeline
- Permitted Location
- Dry Hole
- Oil Well
- Gas Well
- Oil/Gas Well
- Plugged Oil Well
- Plugged Gas Well
- Canceled Location
- Plugged Oil/Gas Well
- Injection/Disposal Well
- Sidetrack Well Surface Location

0 12,000 Feet

Luce Bayou Analysis Alternatives 2 and 3

Oil and Gas Wells

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Exhibit	Job No.	Date
13	60018609	January 2007

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Section 3
Conclusion and Recommendations

The Luce Bayou Interbasin Transfer Project has been identified as a means of transferring water from the Trinity River to Lake Houston to meet future water demands of the Houston metropolitan area. As currently proposed, up to 400 MGD of raw water would be pumped from the Trinity River and conveyed either to Lake Houston or directly to the City of Houston NEWPP. Engineering and environmental analyses for the project identified nine alternatives for conveying water from the Trinity River basin to the San Jacinto River basin. The alternatives are described in Section 1.

The engineering analysis concluded that all nine identified alternatives are technically feasible of being accomplished to meet the purpose of and need for the project. However, the costs of construction of the alternatives vary from an estimated $160 million to $940 million (2006 dollars). The cost of construction, operation, and maintenance of the conveyance facility is a critical component to the economic viability of the project. Therefore, cost of construction is a factor influencing the selection of practicable alternatives. The engineering analysis determined that the estimated costs of construction for Alternatives 1, 2, and 3 were significantly less than the estimated construction costs for Alternatives 4 through 6a. However, the lack of water rights to pump water from Lake Livingston to Lake Houston makes Alternative 1 logistically infeasible. Alternatives 2 and 3 were therefore identified as the practicable alternatives to carry forward for additional investigations.

An environmental constraints analysis was conducted for the nine project alternatives. Environmental criteria were identified and available data associated with each criterion were obtained. The alternatives were evaluated based upon quantitative data and methodology. The alternatives were scored using a screening threshold and a weighting factor assigned to each environmental criterion. A comparison of the scores calculated for each alternative, which ranged from 6.5 to 18, revealed that Alternatives 2 and 3 scored the lowest of the nine identified alternatives (10 and 6.5, respectively). The lower scores indicate that these alternative routes have more favorable environmental conditions or the least number of issues to be addressed as compared to other alternatives. Similar to the engineering analysis, Alternatives 2 and 3 were identified as the practicable alternatives to carry forward for more additional investigations.

Additional evaluation of Alternatives 2 and 3 was conducted and is provided in Section 2. The analysis was primarily based on the data compiled during the constraints analysis. Environmental data were obtained and evaluated for the general area of the two practicable alternatives. A segment of pipeline and canal extending southwestward from the Capers Ridge Pump Station are common elements of both alternatives. Alternative 2 would convey Trinity River water through the Luce Bayou channel to Lake Houston, while Alternative 3 would convey Trinity River water through a constructed canal south of Luce Bayou for a majority of its length before discharging into the downstream portion of Luce Bayou. Alternative 2 would require reconfiguration of the natural channel of Luce Bayou to accommodate additional flow. The channel reconfiguration would alter habitat conditions within and adjacent to the channel. Alternative 3 would primarily traverse areas in active agricultural production. A site visit to the project area with representatives of the USFWS and the TPWD indicated that these agencies would not support the construction of Alternative 2 due to potential environmental impacts to Luce Bayou. Because of the disturbed condition of the areas in agricultural use, potential environmental impacts associated with Alternative 3 (construction of a canal) would be less than the potential environmental impacts associated with the implementation of Alternative 2 (Luce Bayou channel). Based on resource agency concerns and the analysis conducted, Alternative 3 would represent the least environmentally damaging practicable alternative. Detailed environmental and engineering studies will need to be performed to define the elements of the water conveyance project

and the permitting requirements associated with project implementation. For example, a preliminary jurisdictional determination will be needed to identify potential waters of the United States, including wetlands that may be impacted by the project. Hydraulic, topographic, hydrologic, and geomorphological studies would be needed to understand the potential impacts to the environment in order to develop appropriate compensation or mitigation plans associated with the pumping and conveyance of water from the Trinity River across Liberty and Harris Counties to Lake Houston. Cultural resource investigations (archeological and historical) would be performed during canal and pipeline route studies. Phase I Environmental Site Assessments or hazardous materials/waste investigations would provide information to be used for property or easement acquisition. Numerous other studies would also be needed for the conceptual and preliminary engineering design for the successful permitting and construction of the Luce Bayou Water Interbasin Transfer Project.

Section 4
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Appendix A- Site Visits

Site Visit Observation Report

Project Name: **Luce Bayou Interbasin Transfer Project** Project Number: **60011836**

Date: **July 12, 2006** Arrival Time: **9:00am** Departure Time: **4:30pm**

Project Rep:

Contractor:

Purpose:

The alternatives were detailed on the site visit – including stops at various Luce Bayou crossings, the Dayton Canal, and several pipeline easements – in order to gain a better understanding of the potential issues and concerns with each.

Talked With:

TCB Employees in Attendence

Ron Kelling, Project Manager
Roy Knowles, Project Environmental Scientist
Kelly Krenz, Task Manager - Environmental
David Kubala, Task Manager - Engineer
Erin Williford, Project Engineer

Site Conditions:

n/a

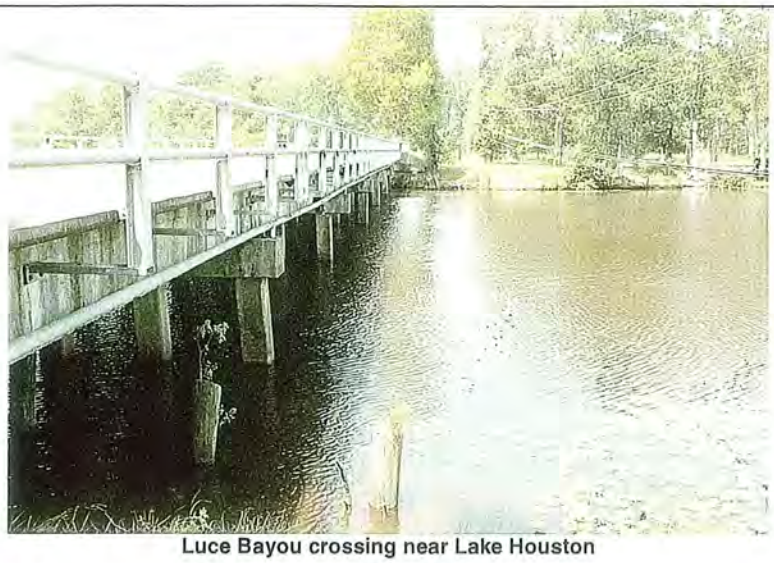
Observations:

Luce Bayou at FM 1008 – narrow channel upstream of the crossing, expanding downstream

Luce Bayou at FM 321 – notice wider channel available

Luce Bayou looking downstream just west of FM 321 – notice heavily wooded channel and surrounding areas

Luce Bayou at FM 2100 – much wider channel



Luce Bayou crossing near Lake Houston

Dayton Canal covered with vegetation

Existing pipeline crossing – potential location of diversion pipeline

Remarks:

Site visit was productive; it highlighted the general conditions of the area and provided an overall picture of each alternative. In addition, potential costly issues were identified and can be used in future alternative analysis.

Erin Williford

TCB Staff Member

Site Visit Observation Report

Project Name: **Luce Bayou Interbasin Transfer Project** Project Number: **60011836**

Date: **July 19, 2006** Arrival Time: **2:00pm** Departure Time: **5:00pm**

Project Rep:

Contractor:

Purpose:

The site visit was scheduled with Coastal Water Authority to provide information with regards to the operation and maintenance of the Trinity River Pump Station and associated canal.

Talked With:

Pump Station Represenatives

Jerry Berry, Manager of Operations
James Lewis, Superintendent
Al, Operator
Wilson, Head Operator

TCB Employees in Attendence

Steve Fenney, Project Engineer
Ron Kelling, Project Manager
Kelly Krenz, Task Manager - Environmental
avid Kubala, Task Manager - Engineer
rin Williford, Project Engineer

Espey Employees in Attendence

Chuck Settle

Site Conditions:

n/a

Observations:

Pump Station Issues and Concerns

1. One operator lives on site.
2. At least one operator on duty 24 hours a day, 7 days a week.
3. During construction of current expansion, cracks formed in the Control Room Building as temporary sheet piling was removed. (Use of temporary sheet piling versus permanent sheet piling should be evaluated. Consider improvements to Control Room Building for TRPS alternative. Consider possible additional accommodations for personnel during hurricanes.)
4. Once construction is completed, pump station will have installed capacity of 1.2 BGD.
5. Operations personnel would prefer two standby pumps in addition to that needed for firm capacity.
6. Wooden pile bumpers in the river in front of the screens are damaged by floating debris in the river. They will be replaced with steel bumpers in this construction project.
7. Current pumps are low lift (approx. 5 psi)
8. Secondary feed currently under construction.
9. Lubrication and inspection of pump bearings occurs every two hours to minimize load and wear on pumps.
10. Clearing debris from the intake mechanism is required often.
11. The Lynchburg facility monitors and controls the water levels of the system.
12. The larger pumps at the station can pump 60,000 to 66,000 gpm and the smallest pump can pump 30,000 gpm.

The expansion currently under construction is adding another bay for additional pumps.

13. Electricity currently costs $300,000 per month and an additional $2 million is being added to the budget for electricity next year.

Pumps at Trinity River Pump Station

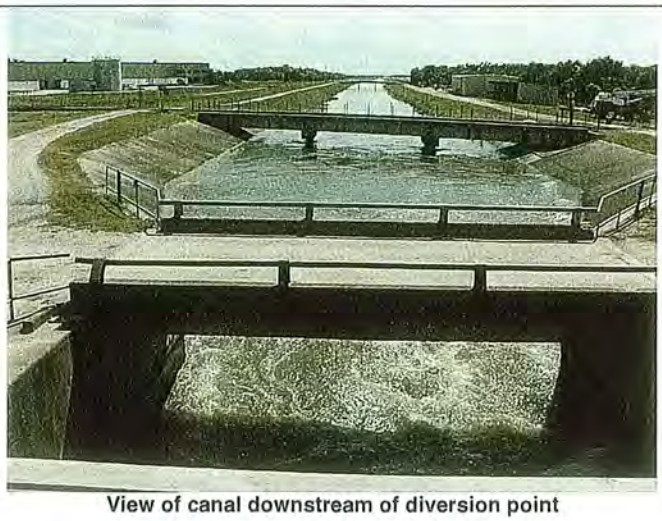
Settling Basin Issues and Concerns

1. Annual dredging is needed which requires machinery and a waste material disposal location on site.
2. Multiple ponds are required for dredging. One pond is used to pump dredged material. The other pond(s) are used to hold the dredged material until the water has evaporated.
3. The dredged material is primarily good river sand. The sand would have a market for land developers and contractors however the costs to haul it to a point of use are very costly due to the remoteness of the TRPS
4. Silt in canal is kept to a minimum with a settling basin at the head waters.
5. In consideration of a pipeline, silt would be of an issue in the pipeline plus a settling basin would be required at the end of the pipeline.
6. Dredger was design specifically for the 16.5-feet deep TRPS settling basin.
7. It usually takes three to four months to remove the dredged material from the site.

Settling basin directly adjacent to pump station

General Canal Issues and Concerns

1. Evaporation and seepage losses are estimated at 8 – 15% along existing 22 mile canal corridor.
2. Public access to canals provides liability/safety issues.
3. Homeowners adjacent to canals storing personal items in CWA ROW pose additional maintenance issues.
4. During power failures channel is altered with "log jams" or clay walls (stockpiles of clay stored on the bank of the canal to use during an emergency) to ensure drinking water for specific clients.
5. Canals alter the natural drainage and can cause problems during storm events.



View of canal downstream of diversion point

Canal Maintenance Issues and Concerns

1. Frequent mowing of ROW, especially during warmer seasons, requires 5 full time employees and 5 tractor mowers.
2. Continual berm maintenance is needed to repair holes/breeches/collapsed walls. Must address sloughing side slopes as they appear since the problem only gets worse. Sloughing of side slopes a problem especially during wet periods. It is difficult to get equipment in place and then stabilized. Usually install sandbags as temporary fix then after the area dries, repair the side slope. Alligators and crawfish appear to burrow into the side slopes. Once they burrow all the way to the other side, water leaks out causing more issues.
3. Machinery including brush hogs, backhoes, and dozers are required to remove heavy vegetation and growth throughout the canal.
4. CWA has a total of 17 full time employees maintaining the 22 miles of canal. This includes the 5 employees dedicated to mowing.
5. The west canal is concrete lined and experiences algal growth that disengages and clogs the system making it difficult to keep the bar screens clean. Weed growth in the concrete cracks, soil build up, and clam growth cause additional problems. Herbicides are being allowed in the coming year to help control aquatic vegetation and hopefully reduce maintenance.
6. The superintendent has the following resources for maintenance: 15 people, 3 backhoes, 1 rubber backhoe, 5 brush hogs, 1 mobile crane, 1 compactor, 1 cutter dredge boat.

Example of sloughing of side slopes along canal – a major maintenance issue

Siphon Issues and Concerns

1. Heavy vegetation accumulation on bar screens needs to be constantly monitored and removed. Vegetation at the Cedar Bayou siphon shown had accumulated since the previous day. This siphon is cleaned three times each week.
2. Siphon pipes need to be up kept to ensure minimal loss of water due to leakage or other maintenance issues.
3. Cedar Bayou siphon has the greatest capacity. I-10 siphon is the longest.

Vegetation build-up on Cedar Bayou Siphon one day after clearing

Remarks:

Overall, the site visit to the TRPS was successful. Many issues were discussed and should be included in any further alternative analysis with respect to pump stations and canals.

Erin Williford

TCB Staff Member

Site Visit Observation Report

Project Name: **Luce Bayou Interbasin Transfer Project** Project Number: **60011836**

Date: **August 10, 2006** Arrival Time: **7:30am** Departure Time: **2:00pm**

Project Rep:

Contractor:

Purpose:

The site visit was scheduled for general reconnaissance for Alternative 1 (POD – Lake Livingston). Photographs of Lake Livingston, Sand Creek, and the east fork of the San Jacinto River were taken.

Talked With:

TCB Employees in Attendence

Jeremy Hanzlik, Project Engineer (Environmental)
Erin Williford, Project Engineer

Ecologic, Inc. Employees in Attendence

Anne Profilet

KBR Employees in Attendence

Lucia Lee

te Conditions:

n/a

Observations:

Lake Livingston – Possible Point of Diversion (POD) Location for Alternative 1

1. This POD is located east of FM 224 near the mouth of Wolf Creek.
2. Wolf Creek Park/Campground run by the TRA is directly adjacent to current possible pump station location. Future issues with the park service are foreseen if PS is to be built.
3. It appears that hidden locations may be feasible however noise pollution on the lake could be a problem.

Standing on bank at Wolf Creek Park looking upstream from Lake Livingston towards Wolf Creek, bridge is FM 224

Looking towards junction of Wolf Creek and Lake Livingston

FM 946 and Sand Creek (Very Upper Reaches)

1. Located approximately 400 feet north of the intersection of FM 946 and FM 156, Sand Creek (or the remnants of Sand Creek) cross FM 946.
2. There is no sign marking the location, however two object markers denote the culvert crossing.
3. It appeared that Sand Creek was not a continuous creek at this location however, it is possible that debris has collected along the fence line creating a silted barrier where water flows south after ponding to a certain depth.

Looking South on FM 946 towards intersection with FM 156, object markers point out box culvert location at upper end of Sand Creek

Looking southwest at Sand Creek cross culverts at FM 946

Looking west on FM 946 downstream of box culvert at upper end of Sand Creek

FM 945 and Sand Creek

1. Defined creek at this location.
2. Substantial depth and width with dense vegetation along bank.

Sand Creek box culverts at FM 945

Looking south toward FM 945 at Sand Creek box culverts

Sand Creek at FM 945 – looking upstream

East Fork of the San Jacinto River at FM 150

1. This crossing is directly downstream of the confluence of Sand Creek and the east fork of the San Jacinto River.
2. River appears to be well maintained in the ROW of FM 150, but the dense vegetation impedes any visibility upstream and downstream of the bridge.

Bridge over San Jacinto River at FM 150

Looking downstream (south) from east bank of the San Jacinto River

FM 150 bridge over San Jacinto River

Remarks:

Overall the site visit was beneficial.
Details of possible pump station location need to be reviewed with considerations listed above.
Alternative appears to be feasible from initial site reconnaissance.

Erin Williford
TCB Staff Member

Site Visit Observation Report

Project Name: **Luce Bayou Interbasin Transfer Project** Project Number: **60018609**

Date: **October 4, 2006** Arrival Time: **9:00am** Departure Time: **4:30pm**

Project Rep:

Contractor:

Purpose:
The purpose of the site visit was to visit various locations along Luce Bayou that can only be accessed through permission from private land owners. Feasibility of Alternative 2 (Luce Bayou in natural state) and Alternative 3 (canal to junction at Luce Bayou) was discussed.

Talked With:

CWA Employees in Attendence
Jerry Berry
Lee Casey

Land Owners in Attendence
Carell Freeman
Ray Stoesser

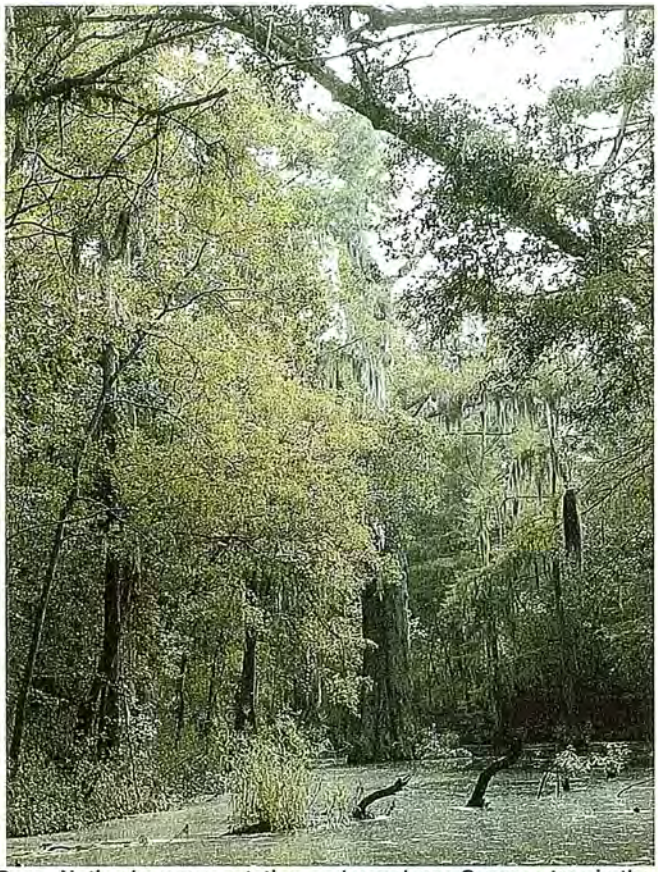
Ecologic, Inc. Employees in Attendence
Anne Profilet

TCB, Inc. Employees in Attendence
Roy Knowles, Project Environmental Scientist
Kelly Krenz, Task Manager – Environmental
David Kubala, Task Manager – Engineer
Michael Kane, Project Engineer
Erin Williford, Project Engineer

Site Conditions:
n/a

Observations:
See photographs below for various site conditions.

Luce Bayou adjacent to reservoir on Reidland Farm, upstream of Reidland Dam, downstream of Tarkington Bayou. Notice the Cypress trees lining the waterway – this is common in this area of the bayou.



Luce Bayou at Reidland Dam. Notice heavy vegetation and very large Cypress tree in the middle of the bayou.

Luce Bayou directly downstream of Reidland Dam. Downed tree trunks are common in the bayou where debris is collected causing back up of water.

Cypress trees and other vegetation along shallow section of Luce Bayou farther downstream of Reidland Dam.

Luce Bayou upstream of Tarkington Bayou and downstream of SH 321. Notice dry bed and sharp angled banks with exposed/eroded root systems.

Luce Bayou upstream of Tarkington Bayou downstream of SH 321. Notice steep banks on left of picture and trees on both banks leaning towards bayou.

Luce Bayou very near Lake Houston. Notice wide expanse of water and large fallen tree due to erosion of sandy soils.

Remarks:

Site visit was productive; it became evident that if Alternative 2 was chosen for design that many modifications would have to be made to Luce Bayou, especially in the upper reaches. Concerns with putting additional flow down Luce Bayou include the potential for drastically increased erosion of the sandy soils and much disturbance of the existing ecosystem.

Erin Williford

TCB Staff Member

Capers Ridge Pump Station

Photo Area No. 1

Photo Area No. 2

Photo Area No. 3

Photo Area No. 4

Photo Area No. 5

Photo Area No. 6

Photo Area No. 7

Photo Area No. 8

Note: H-GAC Imagery 2002 & 2004

Luce Bayou
Site Visit - October 4, 2006

N W E S

7,500 3,750 0 7,500 Feet

Legend

- Luce Photo Points
- Potential Alternatives: Pipeline, Canal
- Floodplain Boundaries: Floodway, 100-Year Floodplain

TCB | AECOM

Note: H-GAC Imagery 2004

N
W E
S

200 100 0 200 Feet

Luce Bayou
Site Visit - October 4, 2006
Photo Area No. 1

Legend

- Luce Photo Points
- Potential Alternatives: Pipeline, Canal
- Floodplain Boundaries: Floodway, 100-Year Floodplain

TCB | AECOM

Photo 1-1 Luce Bayou channel west of SH 321 showing debris collected on vegetation within the channel.

Photo 1-2 Typical Luce Bayou channel west of SH 321. Note stream bank erosion.

Note: H-GAC Imagery 2004

N
W E
S

200 100 0 200 Feet

Luce Bayou
Site Visit - October 4, 2006
Photo Area No. 2

Legend

- Luce Photo Points
- Potential Alternatives: Pipeline, Canal
- Floodplain Boundaries: Floodway, 100-Year Floodplain

TCB | AECOM

Photo 2-1 Typical channel of Luce Bayou west of SH 321.

Photo 2-2 Typical channel of Luce Bayou west of SH 321.

Photo 2-3 Eroded channel bank of Luce Bayou showing exposed roots that may result in tree-falls into the channel.

Photo 2-4 Typical channel of Luce Bayou west of SH 321 with fallen tree in the channel.

Note: H-GAC Imagery 2004

N
W E
S

200 100 0 200 Feet

Luce Bayou
Site Visit - October 4, 2006
Photo Area No. 3

Legend

- Luce Photo Points
- Potential Alternatives: Pipeline, Canal
- Floodplain Boundaries: Floodway, 100-Year Floodplain

TCB | AECOM

Photo 3-1 Typical channel of Luce Bayou downstream of SH 321 showing eroded condition along channel bank.

Photo 3-2 Typical channel of Luce Bayou downstream of SH 321. Culverts associated with utility easement crossing in background.

Photo 3-3 Looking at eroded bank of Luce Bayou channel downstream of SH 321.

Note: H-GAC Imagery 2004

N
W E
S

200 100 0 200 Feet

Luce Bayou
Site Visit - October 4, 2006
Photo Area No. 4

Legend

- Luce Photo Points
- Potential Alternatives: Pipeline, Canal
- Floodplain Boundaries: Floodway, 100-Year Floodplain

TCB | AECOM

Photo 4-1 Looking upstream at Luce Bayou near pump station adjacent to reservoir on south side of channel.

Photo 4-2 Looking downstream at Luce Bayou near pump station adjacent to reservoir on south side of channel.

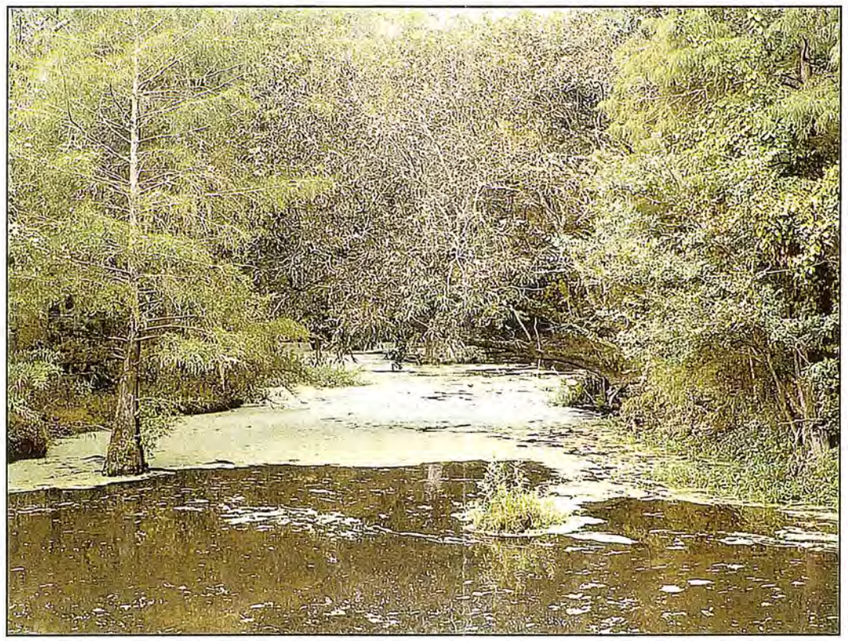
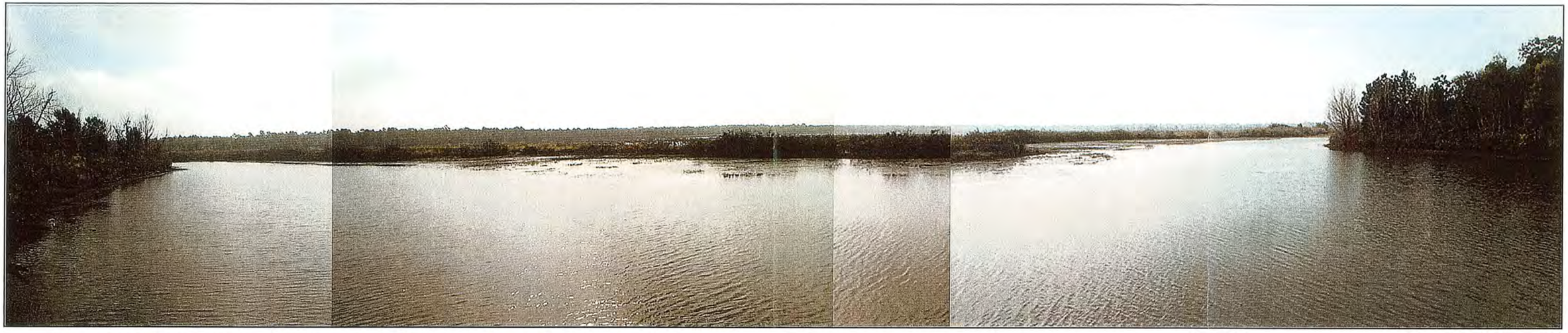


Photo 4-3 Looking downstream at Luce Bayou near pump station adjacent to reservoir on south side of channel.



Reservoir near pump station on south side of Luce Bayou channel.

Note: H-GAC Imagery 2004

N
W E
S

200 100 0 200 Feet

Luce Bayou
Site Visit - October 4, 2006
Photo Area No. 5

Legend

- Luce Photo Points
- Potential Alternatives: Pipeline, Canal
- Floodplain Boundaries: Floodway, 100-Year Floodplain

TCB | AECOM

Photo 5-1 Impounded area of Luce Bayou upstream of Riedland Dam.

Photo 5-2 Eroded bank of Luce Bayou immediately downstream of Reidland Dam.

Photo 5-3 Reidland Dam.

Photo 5-4 Tree fall and debris within Luce Bayou channel downstream of Reidland Dam.

Note: H-GAC Imagery 2004

N
W E
S

200 100 0 200 Feet

Luce Bayou
Site Visit - October 4, 2006
Photo Area No. 6

Legend

- Luce Photo Points
- Potential Alternatives: Pipeline, Canal
- Floodplain Boundaries: Floodway, 100-Year Floodplain

TCB | AECOM

Photo 6-1 Typical channel of Luce Bayou near pipeline crossing west of reservoir.

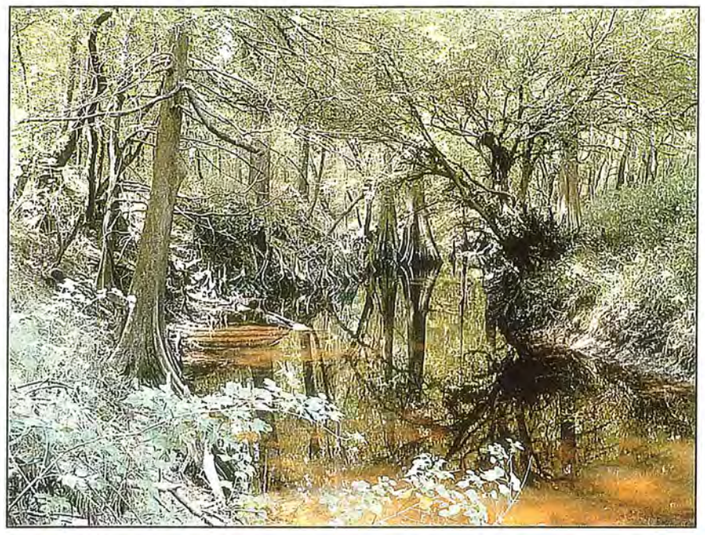
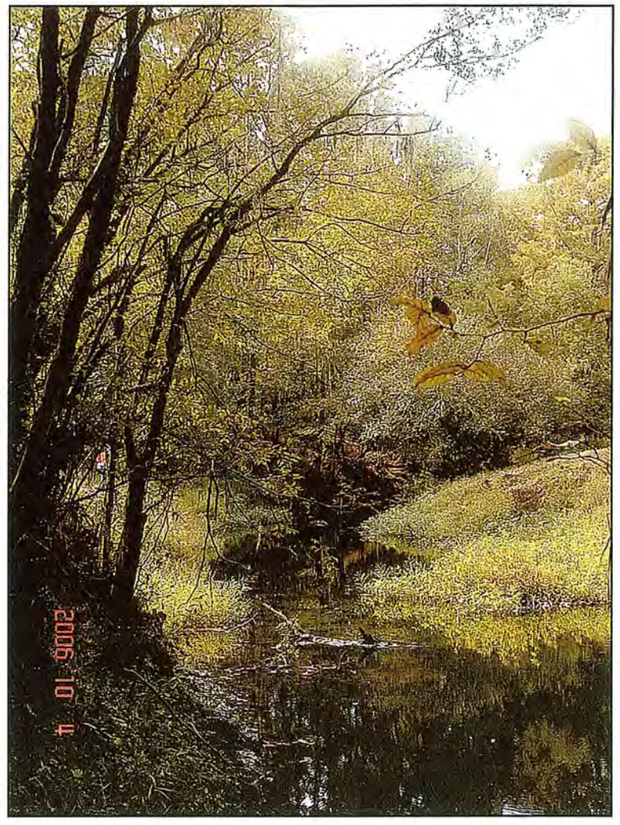


Photo 6-2 Typical channel of Luce Bayou near pipeline crossing west of reservoir.

Photo 6-3 Pipeline easement crossing of Luce Bayou.

Photo 6-4 Pipeline easement crossing of Luce Bayou.



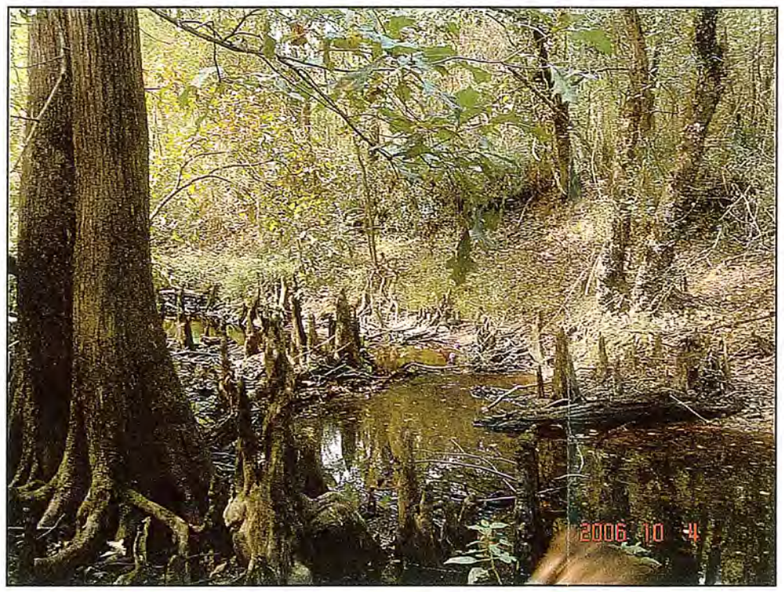


Photo 6-5 Bald cypress trees and root "knees" protruding from Luce Bayou channel.

Note: H-GAC Imagery 2004

N
W E
S

200 100 0 200 Feet

Luce Bayou
Site Visit - October 4, 2006
Photo Area No. 7

Legend

- Luce Photo Points
- Potential Alternatives: Pipeline, Canal
- Floodplain Boundaries: Floodway, 100-Year Floodplain

TCB | AECOM

Photo 7-1 Pipeline easement crossing of Luce Bayou.

Photo 7-2 Typical channel of Luce Bayou near pipeline crossing.

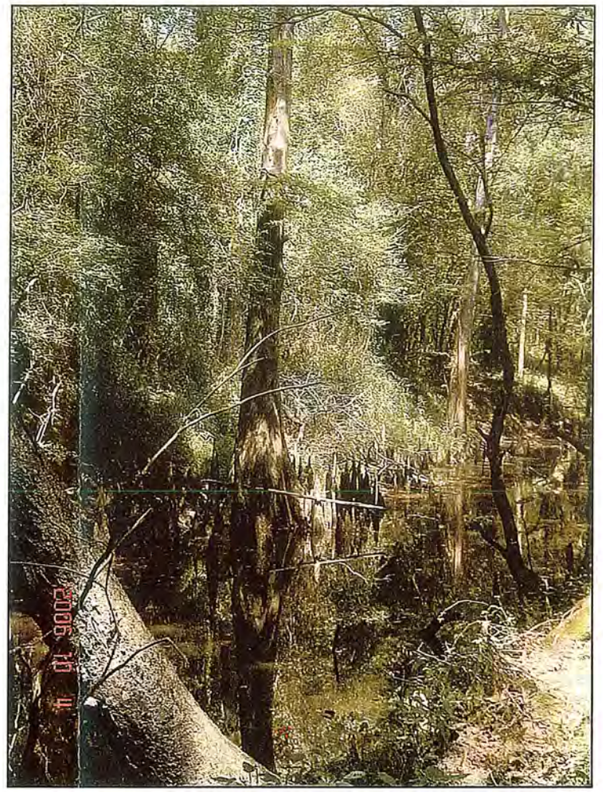


Photo 7-3 Typical channel of Luce Bayou near pipeline crossing.

Photo 7-4 Typical channel of Luce Bayou near pipeline crossing.

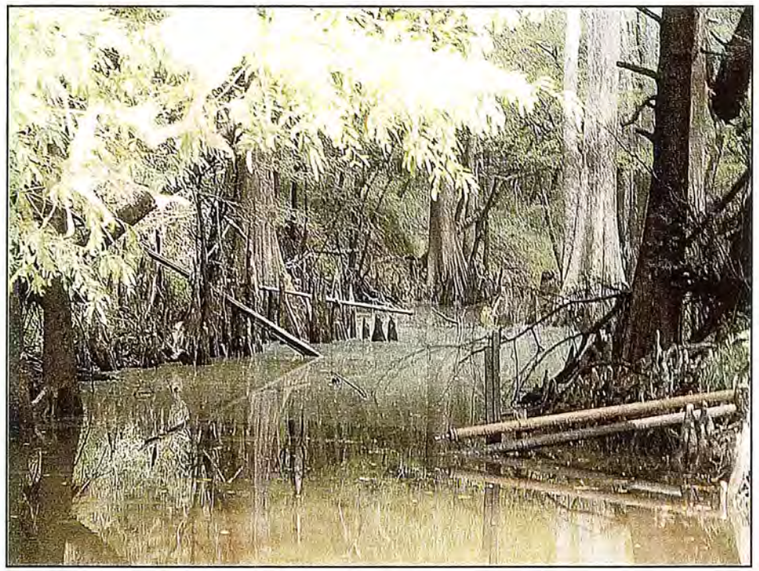


Photo 7-5 Typical channel of Luce Bayou near pipeline crossing with monitoring equipment associated with a USGS stream gauge station in foreground.

Note: H-GAC Imagery 2004

N
W E
S

200 100 0 200 Feet

Luce Bayou
Site Visit - October 4, 2006
Photo Area No. 8

Legend

- Luce Photo Points
- Potential Alternatives: Pipeline, Canal
- Floodplain Boundaries: Floodway, 100-Year Floodplain

TCB | AECOM

Photo 8-1 Luce Bayou channel near subdivision park. Water level reflects pool elevation of Lake Houston.

Photo 8-2 Luce Bayou channel and tributary drainage (background) entering channel near subdivision park.

Photo 8-3 Eroded bank of Luce Bayou with tree-fall in channel. Note sandy nature of soil.

Photo 8-4 Eroded bank of Luce Bayou.

Appendix B- Reference Documents

Section 1	Brown and Root Plans - Site preparation of River Pump Station and Appurtenances
Section 2	Brown and Root Plans – Trinity River Pump Station and Maintenance Facility
Section 3	Brown and Root Plans – Pipeline Conveyance Facility
Section 4	Brown and Root Plans – Canal Conveyance Facility
Section 5	Brown and Root Plans – Stream Conveyance Facility
Section 6	Brown and Root Plans – CWA Trinity Water Conveyance System and Trinity River Pump Station Plans
Section 7	Alternative Route Profiles
Section 8	Lake Livingston Bathymetry (Hook-N-Line Map Company, Inc.)

Appendix B

Section 2

SITE PREPARATION OF RIVER PUMP STATION AND APPURTENANCES

CONTRACT NO. LBD - 210

LUCE BAYOU DIVERSION PROJECT

WATER DIVISION PROJECT NO. 7392-7

CITY OF HOUSTON, TEXAS

BROWN & ROOT, INC.
ENGINEERS & CONSULTANTS

HOUSTON, TEXAS

N246,461.31
E3,737,475.73

50'(Typical)

N246,670.18
E3,741,329.96
(Point Not Shown To Scale)

N246,605.81
E3,741,124.14
(Point Not Shown To Scale)

N246,113.52
E3,740,215.49

100' 100' 133' 380' 105' 148' 180'

157'

Maint. Area (Future)

℄ Ditch (Future)

Pump Station (Future)

Operator's Residences (Future)

170'

℄ Access Rd. (Future)

℄ 108" Pipelines (Future)

N.G. 42.22' W

TRINITY RIVER

FLOW

N.245,940.83
E.3,740,478.02
(Site of Antiquities Study See Specification For Special Requirements.)

N245,566.76
E3,740,499.25

50'(Typical)

50'(Typical)

Site Boundary And Owner's Property Line

N245,273.89
E3,740,444.66

N 245,114.40
E 3,737,591.81

N245,140.09
E3,738,051.43

Approx. R.O.W. Limits

Approx. R.O.W. Limits

E 3,737,600
E 3,738,000
E 3,738,600
E 3,739,000
E 3,739,500
E 3,740,000
E 3,740,500

LEGEND

40 Existing Contour

Clearing

NOTES:

1. Cleared area along property line shown is approximately 9.0 Acres.
2. Site Boundary shown on this drawing is approximate.
3. The site coordinate system and bearings are related to the Texas Coordinate System, Central Zone. Dimensions shown are ground distance.
4. Site facilities & details shown are for information only, these facilities are future and by others.
5. Field Baseline control points have been established as noted Article VII-08 Of the specifications.
6. Size of Antiquities Study Area is Approximately 75'x75'.

CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS

REVIEWED
DESIGN ENGINEER — MANAGER, ENGINEERING
APPROVED
SANITARY SEWER ENG. — QUALITY WATER ENG.
PAVING ENGINEER — STORM SEWER ENGINEER
PUBLIC BUILDINGS — CONSTRUCTION ENG.
ASSISTANT DIRECTOR — DIRECTOR

NOTES

REVISIONS	BY	DATE

REVISIONS	BY	DATE

Brown & Root, Inc.
Engineers · Consultants

DRAWN BY:
DATE
CHECKED BY
DATE 3-25-65
SCALE

APPROVED

APPROVED

TITLE OF DRAWING: PUMP STATION SITE PREPARATION
AREA PLOT PLAN
NAME OF OWNER: CITY OF HOUSTON
LOCATION LUCE BAYOU, LIBERTY CO. TEXAS

CONTRACT NO. LBD-210
DRAWING NO. SP-210-04

Appendix B

Section 2

TRINITY RIVER PUMP STATION
AND MAINTENANCE FACILITY

CONTRACT NO. LBD-200

LUCE BAYOU DIVERSION PROJECT

WATER DIVISION PROJECT NO. 7392-2

CITY OF HOUSTON, TEXAS

MAYOR

Kathryn J. Whitmire

COUNCILMEN

Larry McKaskle	Dale Gorczynski
Ernest McGowen, Sr.	Ben T. Reyes
George Greanias	Jim Westmoreland
Anthony W. Hall Jr.	Eleanor Tinsley
Frank Mancuso	Jim Greenwood
John G. Goodner	Homer L. Ford
Christin Hartung	Judson Robinson, Jr.

CONTROLLER

Lance Lalor

DEPT. OF PUBLIC WORKS

J.A. Schindewolf - Director

BROWN & ROOT, INC.
ENGINEERS & CONSULTANTS

HOUSTON, TEXAS

N. 246,461.31
E. 3,737,475.73

N246,500

N246,000

N245,500

N245,000

E 3,737,500

E 3,738,000

E 3,738,500

E 3,739,000

E 3,739,500

E 3,740,000

E 3,740,500

N. 246,670.18
E. 3,741,329.96
(Pt. not to scale)

N. 246,605.81
E. 3,741,124.14
(Pt. not to scale)

For Pumping Station
Site Plan See Dwg. CI-02

For Maintenance Area
Site Plan See Dwg. CI-51

For Operator's Residences
Site Plan See Dwg. AA-11

100' 100' 133' 380' 105' 142' 180'

Roadway

Maint. Bldg.

157'

70'

℄ Ditch
See Dwg. CI-15)

N. 246,113.52
E 3,740,218.49

Selective Clearing Limits

120'

℄ Pipeline See Dwg. CI-09

Access Rd. (For Plan & Profile See Dwg. CI-15)

S 73°17'38" E
Access Rd
Sta. 13+27.89

S 73°17'38" E

Spoil Area

N 16°42'22" W

N 19°05' W

Contract Limits
(for Pipeline & Road)
(LBD-200)

By Others
(LBD-300)

N. 245,940.83
E. 3,740,478.02
(Site of Antiquities Study
See Specification
Req'mts.)

FLOW

TRINITY RIVER

N. 245,566.76
E. 3,740,499.25

END FENCING AT
SHORE LINE (TYP.)

END OR TIE-IN
TO EXIST. FENCING

N. 245,114.40
E. 3,737,591.81

N. 245,140.09
E. 3,738,051.43

50' CLR'G. LIMITS (TYP.)

BARBED WIRE FENCING
(SEE DWG. CI-57) TYP.

SITE BOUNDARY AND OWNERS PROPERTY LINE

N. 245,273.89
E. 3,740,444.66

APPROX. R.O.W. LIMITS

LEGEND

- Existing Contour
- BARBED WIRE FENCING
- CLEARED AREA REQ'D. ALONG PROP. LINE.
- Spoil Area

℄ Pipeline #1
℄ Pipeline #2
Slope 1%
Finished Grade
Natural Ground
Spoil
4
1
10' Clearing Limits
El. 50.0

SECTION A-A
N.T.S.

NOTES:

1. For General Civil Notes See Dwg's. CI-04 & CC-01
2. The site boundary shown on this drawing is approximate.
3. The site coordinate system and bearings are related to The Texas Coordinate System Central Zone. Dimensions shown are ground distances.
4. Field Baseline Control Points have been established as noted in Article III of the Specifications.
5. Size of Antiquities site is approx. 75'x 75'.
6. Clearing & Grubbing Limits are shown on Dwg's. CI-04, CI-13 & CI-51.

CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS
REVIEWED
DESIGN ENGINEER — MANAGER, ENGINEERING
APPROVED
SANITARY SEWER ENG. — QUALITY WATER ENG.
PAVING ENGINEER — STORM SEWER ENGINEER
BRIDGE ENGINEER — CONSTRUCTION ENG.
ASSISTANT DIRECTOR — DIRECTOR

NOTES

REVISIONS	BY	DATE	REVISIONS	BY	DATE

Brown & Root, Inc.
Engineers · Consultants
HOUSTON, TEXAS

DRAWN BY: K.A.R.
DATE
CHECKED BY: [illegible]
DATE 7-15-81
SCALE 1"=100'

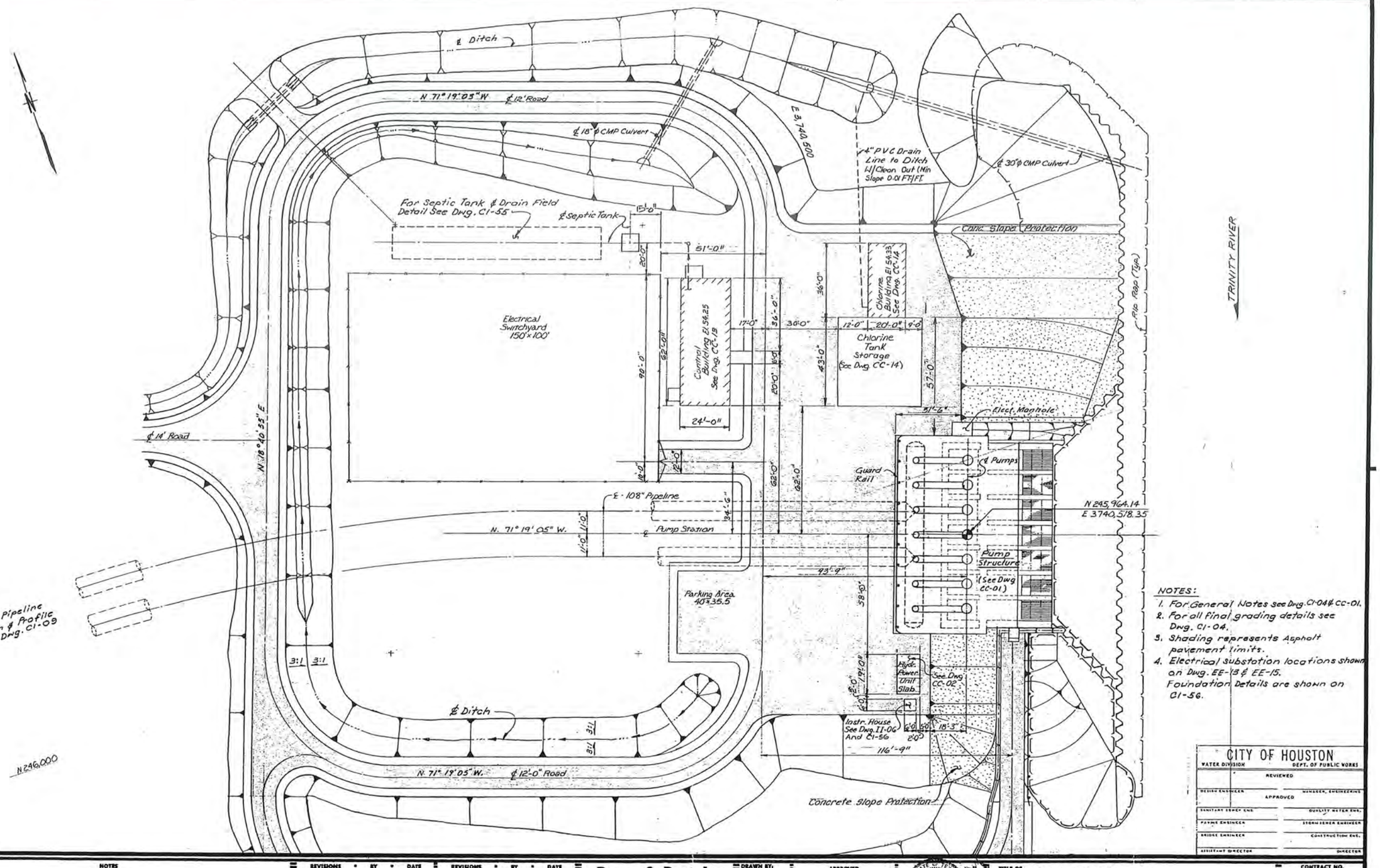
APPROVED

APPROVED

SEAL

TITLE OF DRAWING: PUMP STATION / MAINT. AREA - CIVIL
AREA PLOT PLAN
NAME OF OWNER: CITY OF HOUSTON
LOCATION OF PROJECT: LUCE BAYOU, LIBERTY CO., TEXAS

CONTRACT NO. LBD-200
DRAWING NO. CI-200-01
SHEET 3 OF



NOTES:

1. For General Notes see Dwg. C1-04 & CC-01.
2. For all final grading details see Dwg. C1-04.
3. Shading represents Asphalt pavement limits.
4. Electrical substation locations shown on Dwg. EE-13 & EE-15. Foundation Details are shown on C1-56.

CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS
REVIEWED
DESIGN ENGINEER — MANAGER, ENGINEERING
APPROVED
SANITARY SEWER ENG. — QUALITY WATER ENG.
PAVING ENGINEER — STORM SEWER ENGINEER
BRIDGE ENGINEER — CONSTRUCTION ENG.
ASSISTANT DIRECTOR — DIRECTOR

NOTES

REVISIONS	BY	DATE

REVISIONS	BY	DATE

Brown & Root, Inc.
Engineers · Consultants
HOUSTON, TEXAS

DRAWN BY: M. Martin
DATE: 8/29/80
CHKD BY: Uday
DATE: 7-15-81
SCALE: 1" = 20'

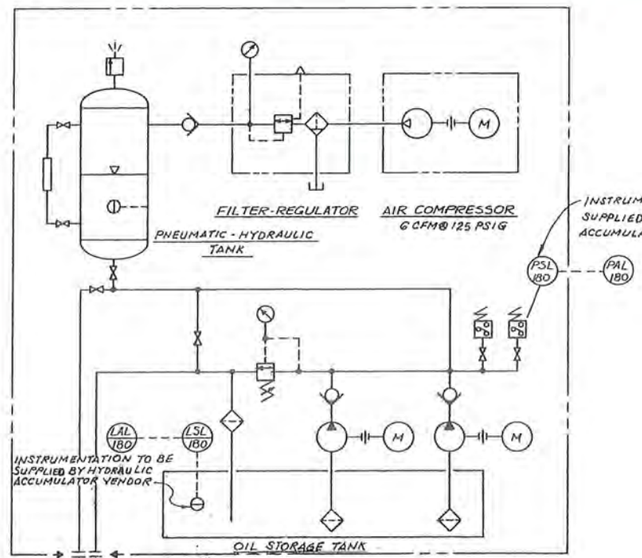
APPROVED

APPROVED

SEAL — GARY W. LEWLEY, 45197, REGISTERED PROFESSIONAL ENGINEER

TITLE OF DRAWING: PUMP STATION - CIVIL
AREA PLOT PLAN
NAME OF OWNER: CITY OF HOUSTON
LOCATION OF PROJECT: LUCE BAYOU, LIBERTY CO. TEXAS

CONTRACT NO. LBD-200
DRAWING NO. C1-200-02
SHEET 4 OF



Z-101
HYDRAULIC ACCUMULATOR PACKAGE UNIT

LEGEND

- GATE VALVE
- BUTTERFLY VALVE
- BALL VALVE
- CHECK VALVE
- FT — FLOW TRANSMITTER
- PIT — PRESSURE INDICATING TRANSMITTER
- FAL — FLOW ALARM LOW
- FISL — FLOW INDICATOR SWITCH LOW
- SOLENOID VALVE
- INTERLOCK (SEE NOTE 2)
- SOLENOID VALVE
- TO INSTRUMENT CONTROL PANEL (SEE NOTE 2)
- MOTORIZED VALVE
- PSL — PRESSURE SWITCH LOW
- PAL — PRESSURE ALARM LOW
- M — MOTOR
- PUMP
- PRESSURE SWITCH
- FLANGE
- FILTER OR STRAINER
- REGULATOR
- CHECK VALVE
- LEVEL SWITCH
- RELIEF VALVE
- ADJUSTABLE RELIEF REGULATOR
- FILTER
- PI — PRESSURE INDICATOR
- LAL — LEVEL ALARM LOW
- LSL — LEVEL SWITCH LOW
- FV — FLOW VALVE

CONTRACT LIMITS

FT 101 A — 108"VF-2 — 108"-RW-(PIPE LINE#2)

FT 101 B — 108"VF-2 — 108"-RW-(PIPE LINE#1)

1 1/2"-RW-02 SAMPLE WATER
1 1/2"-RW-03 SAMPLE WATER

3"-BL-09-C
2"-HO-08-H
2 1/2"-HO-09-H
108"-RW- MANIFOLD
6"-CS-05-G

3/4"-BL-07-C · 3/4"VG-1 · FV 178A · 48"VF-1 · 48"VB-1 · FV 176 · PI 176 · FV 174 · 3/4"VG-1 · 1"VG-6 · 1"-HO-07-H · FV 178B
3/4"-BL-06-C · 3/4"VG-1 · FV 168A · 48"VF-1 · 48"VB-1 · FV 166 · PI 166 · FV 164 · 3/4"VG-1 · 1"VG-6 · 1"-HO-06-H · FV 168B
3/4"-BL-05-C · 3/4"VG-1 · FV 158A · 48"VF-1 · 48"VB-1 · FV 156 · PI 156 · FV 154 · 3/4"VG-1 · 1"VG-6 · 1"-HO-05-H · FV 158B
3/4"-BL-04-C · 3/4"VG-1 · FV 148A · 48"VF-1 · 48"VB-1 · FV 146 · PI 146 · FV 144 · 3/4"VG-1 · 1"VG-6 · 1"-HO-04-H · FV 148B
3/4"-BL-03-C · 3/4"VG-1 · FV 138A · 48"VF-1 · 48"VB-1 · FV 136 · PI 136 · FV 134 · 3/4"VG-1 · 1"VG-6 · 1"-HO-03-H · FV 138B
3/4"-BL-02-C · 3/4"VG-1 · FV 128A · 48"VF-1 · 48"VB-1 · FV 126 · PI 126 · FV 124 · 3/4"VG-1 · 1"VG-6 · 1"-HO-02-H · FV 128B
3/4"-BL-01-C · 3/4"VG-1 · FV 118A · 48"VF-1 · 48"VB-1 · FV 116 · PI 116 · FV 114 · 3/4"VG-1 · 1"VG-6 · 1"-HO-01-H · FV 118B

FROM CHLORINE CONTROL PANEL (PUMP STATION) 3"-CS-07-G
FROM CHLORINE CONTROL PANEL (PUMP STATION) 3"-CS-06-G
FROM CHLORINE CONTROL PANEL (PUMP STATION) 3"-CS-05-G
FROM CHLORINE CONTROL PANEL (PUMP STATION) 3"-CS-04-G
FROM CHLORINE CONTROL PANEL (PUMP STATION) 3"-CS-03-G
FROM CHLORINE CONTROL PANEL (PUMP STATION) 3"-CS-02-G
FROM CHLORINE CONTROL PANEL (PUMP STATION) 3"-CS-01-G

FV 177 · FISL 174 · PIT 175 · 48"RW · 8"VG-2 · 8"VC-3 · 8" COMB. AIR VAC. VALVE · 3" DIFFUSER HEADER (TYP. P-7)
FV 167 · FISL 164 · PIT 165 · 48"RW · 8"VG-2 · 8"VC-3 · 8" COMB. AIR VAC. VALVE
FV 157 · FISL 154 · PIT 155 · 48"RW · 8"VG-2 · 8"VC-3 · 8" COMB. AIR VAC. VALVE
FV 147 · FISL 144 · PIT 145 · 48"RW · 8"VG-2 · 8"VC-3 · 8" COMB. AIR VAC. VALVE
FV 137 · FISL 134 · PIT 135 · 48"RW · 8"VG-2 · 8"VC-3 · 8" COMB. AIR VAC. VALVE
FV 127 · FISL 124 · PIT 125 · 48"RW · 8"VG-2 · 8"VC-3 · 8" COMB. AIR VAC. VALVE
FV 117 · FISL 114 · PIT 115 · 48"RW · 8"VG-2 · 8"VC-3 · 8" COMB. AIR VAC. VALVE

12"-RW-03
12"-RW-02
6"-CS-03-G
3"-BL-03-C
6"-RW-01-C
2"-BL-08-D
MF-200-03

P-107
RIVER WATER PUMP
49,600 GPM @ 108 TDH
1750 HP @ 600 RPM

P-106
RIVER WATER PUMP
49,600 GPM @ 108 TDH
1750 HP @ 600 RPM

P-105
RIVER WATER PUMP
49,600 GPM @ 108 TDH
1750 HP @ 600 RPM

P-104
RIVER WATER PUMP
49,600 GPM @ 108 TDH
1750 HP @ 600 RPM

P-103
RIVER WATER PUMP
49,600 GPM @ 108 TDH
1750 HP @ 600 RPM

P-102
RIVER WATER PUMP
49,600 GPM @ 108 TDH
1750 HP @ 600 RPM

P-101
RIVER WATER PUMP
49,600 GPM @ 108 TDH
1750 HP @ 600 RPM

CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS
REVIEWED
DESIGN ENGINEER — MANAGER, ENGINEERING
APPROVED
SANITARY SEWER ENG. — QUALITY WATER ENG.
PAVING ENGINEER — STORM SEWER ENGINEER
BRIDGE ENGINEER — CONSTRUCTION ENG.
ASSISTANT DIRECTOR — DIRECTOR

NOTES

1. * MATERIAL SUPPLIED WITH CHLORINATION EQUIP.
2. SEE INSTRUMENT FLOW DIAGRAM DRAWINGS II-200-11 & 12 FOR COMPLETE CONTROL SCHEME.
3. ** INSTRUMENTS TO BE SUPPLIED BY 48" VALVE VENDOR.

REVISIONS	BY	DATE

REVISIONS	BY	DATE

Brown & Root, Inc.
Engineers · Consultants
HOUSTON, TEXAS

DRAWN BY: dh
DATE 12-11-80
CHK'D BY: AK
DATE 2/14/81
SCALE:

APPROVED

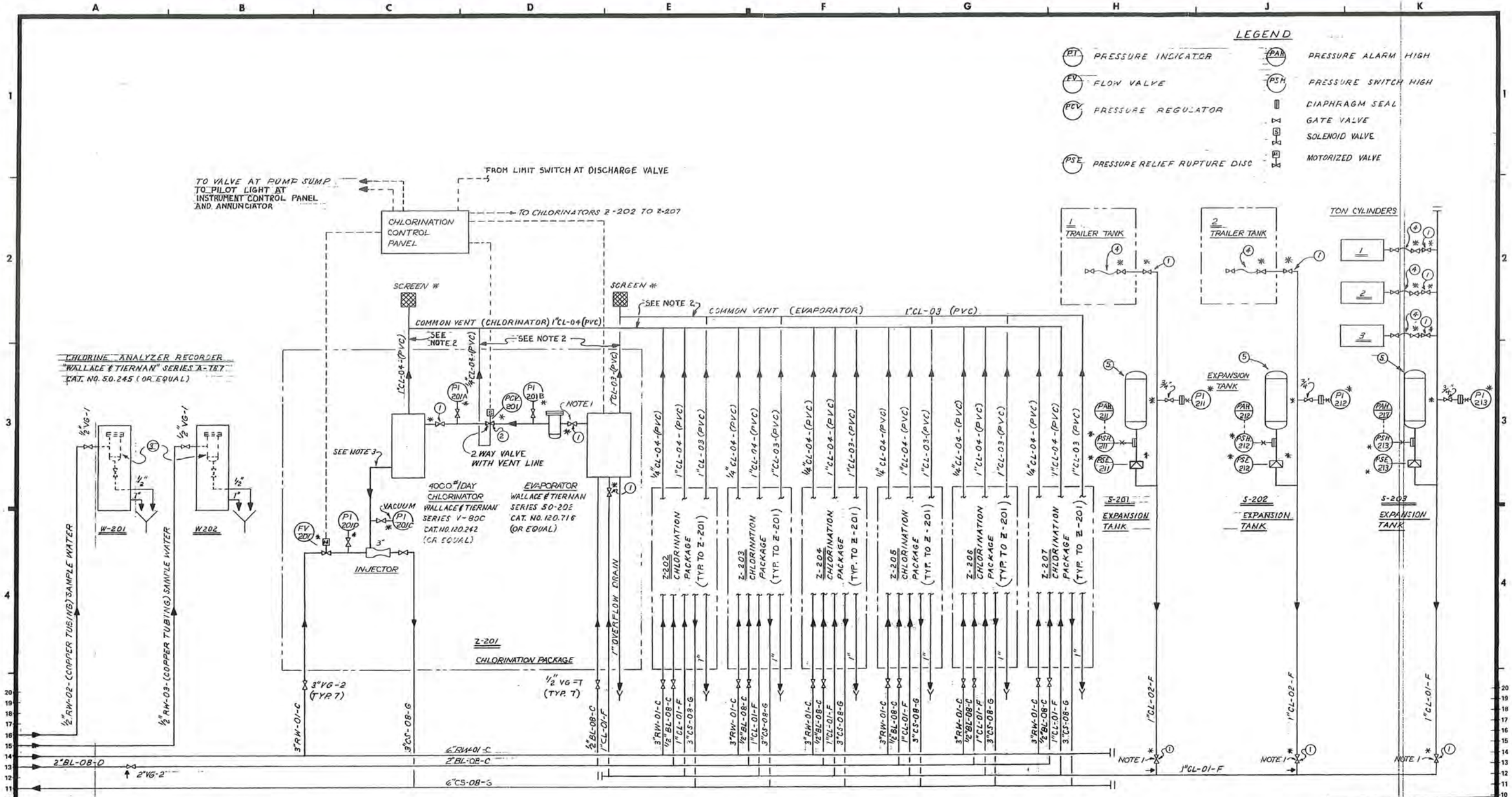
APPROVED

STATE OF TEXAS — GARY W. LEWLEY — 45587 — REGISTERED ENGINEER

TITLE OF DRAWING: PUMP STATION/MAINT AREA - FLOW DIAGRAMS
RIVER WATER PUMPING SYSTEM
NAME OF OWNER: CITY OF HOUSTON
LOCATION OF PROJECT: LUCE BAYOU LIBERTY CO. TEXAS

CONTRACT NO. LBD-200
DRAWING NO. MF-200-01
SHEET 46 OF

FORM NO. EF-000.84 31-8



* TO BE SUPPLIED WITH CHLORINE EQUIPMENT.

(1) 1" LINE VALVE "WALLACE & TIERNAN" CAT. NO. 130.490 (OR EQUAL)

(2) 1" CHLORINE LOW TEMP. CONTROL SHUTOFF AND PRESSURE REDUCING VALVE "WALLACE & TIERNAN" SERIES A-50-185 WITH ELECTRIC OPERATOR CAT. NO. 130.494 (OR EQUAL)

(3) MOTORIZED FILTER "WALLACE & TIERNAN" CAT. NO. 150.261 (OR EQUAL)

(4) FLEXIBLE CONNECTION COMPLETE WITH VALVES (YOKE TYPE) WALLACE & TIERNAN (OR EQUAL).

(5) LIQUID LINE PRESSURE RELIEF SYSTEM "WALLACE & TIERNAN" CAT. NO. 130.975 (OR EQUAL).

CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS

REVIEWED — DESIGN ENGINEER — MANAGER, ENGINEERING
APPROVED — SANITARY SEWER ENG. — QUALITY WATER ENG.
PAVING ENGINEER — STORM SEWER ENGINEER
BRIDGE ENGINEER — CONSTRUCTION ENG.
ASSISTANT DIRECTOR — DIRECTOR

NOTES

1. VALVE TO BE NORMALLY OPEN. VALVE HANDLE TO BE TAKEN OFF AND STORED IN MAINTENANCE. WAREHOUSE.
2. ALL VENT LINES FROM CHLORINATORS, EVAPORATORS & PRESSURE REDUCING VALVES TO BE PVC PIPING.
3. ALL INJECTOR SUCTION LINES FROM CHLORINATORS TO BE PPL PIPING.

REVISIONS • BY • DATE

REVISIONS • BY • DATE

Brown & Root, Inc.
HOUSTON, TEXAS

DRAWN BY: R.M.J.
DATE 12-15-80
CHK'D BY: B Rowe
DATE 2/14/81
SCALE:

APPROVED

APPROVED

STATE OF TEXAS — GARY W. LEMLEY — 45587 — REGISTERED PROFESSIONAL ENGINEER
SEAL

TITLE OF DRAWING: PUMP STATION / MAINT AREA - FLOW DIAGRAMS
PIPELINE CHLORINATION SYSTEM
NAME OF OWNER: CITY OF HOUSTON
LOCATION OF PROJECT: LUCE BAYOU, LIBERITY CO. TEXAS

CONTRACT NO. LBD - 200
DRAWING NO. MF-200-02
SHEET 47 OF

FORM NO. EF-000-64 21-0

POTABLE WATER CHLORINATOR (PWC)

SUPPLIED BY PWC VENDOR

PI 308

3/4"VG-1

DOMESTIC WATER CHLORINATOR

150# CHLORINE CYLINDER

W-301

ALTERNATOR

HYDRO-PNEUMATIC TANK CONTROL

SUPPLIED BY PWC VENDOR

EJECTOR

WELL PUMP CONTROL

LAL 301 | LSLL 301 | LSH 301 | LSL 301

PUMPS OFF

PUMPS ON

6" OVERFLOW

RESERVED FOR FIRE PROTECTION 6000 GAL.

PSH 311 | FV 311 | STRAINER | PI 320 | FV 301

SET @ 60 PSIG

LSL 311 | PSL 311

PUMPS OFF

PUMPS ON

S-311

2000 GALLONS HYDROPNEUMATIC TANK

K-301 AIR COMPRESSOR 1 CFM @ 100 PSIG

PDAH 301 | PDSH 301

TANK BREATHER

4"BL-12-C

KC 301 | KV 301

1"

S-321 BACKWASH STORAGE TANK 2000 GALLONS

RESIDENCE 20 GPM

RESIDENCE 20 GPM

MAINTENANCE BLDG. 38 GPM

PUMP STATION CONTROL BLDG. 8 GPM.

2"PW-08-D PUMP STATION LAWN SPRINKLER SYSTEM 46 GPM.

2"PW-08-D | 2½"PW-08-B | 3"PW-07-D

2"VG-2 | 2½"VG-2

6"PW-01-B | 2½"PW-04-B | ¾"PW-09-B | 4"PW-05-B

1½"VG-1 | ¾"VG-1

PDSH 303 | PDAH 303

SUPPLIED BY BEARING LUBE VENDOR

FC 309

3¼"VG-1 | 3¼"VG-1 | 2½"VG-2 | 51"

4"VG-2 | 3"VG-2 | 6"VG-2 | 3"VG-2 | 6"VG-4

WATER DRAW-OFF

4"BL-11-C

2½"BL-10-C

S-301 WELL WATER STORAGE TANK 43,600 GALLONS

F-303 IRON FILTER 30 x 60 REGENERANT TANK (SEE NOTE 1)

PI 301 | PI 302 | ¾"VG-1

3¼"VG-1 | 2"VG-2 | 2"VC-3 | 3"VG-2 | 2"VG-2 | 2"VC-3 | 3"VG-2

P-301 | P-302

BEARING LUBE WATER PUMPS 125 GPM @ 235 TDH

2"PW-03-B | 3"PW-02-B | 3"VG-2 | 2"VG-2 | 2"VC-3 | 3"VG-2

PI 311 | ¾"VG-1 | PI 312 | ¾"VG-1

P-311 | P-312

POTABLE WATER PUMPS 150 GPM @ 130 TDH

2"VG-2 | G-VC-3 | 2"VC-3

PI 305 | ¾"VG-1

AIR VALVE

PI 321 | ¾"VG-1

P-321 WELL WATER PUMP 250 GPM @ 216 TDH

PDAH 302 | PDSH 302 | 2½"VG-2 | 51" | 2½"VG-2 | 4"-PW-05-B

24 x 60 REGENERANT TANK (SEE NOTE 1)

F-301 | F-302 IRON FILTERS

3"-BL-09-C/D | 4"-BL-12C

MF-200-01

6"FW-01-E

LEGEND

- PI : PRESSURE INDICATOR
- * : INSTRUMENT ITEMS SUPPLIED BY HYDROPNEUMATIC TANK VENDOR
- GATE VALVE
- CHECK VALVE
- LAL : LEVEL ALARM LOW
- LSL : LEVEL SWITCH LOW
- LSLL : LEVEL SWITCH LOW LOW
- LSH : LEVEL SWITCH HIGH
- PSV : PRESSURE SAFETY VALVE
- PSL : PRESSURE SWITCH LOW
- KC : TIME CYCLE CONTROLLER (BLIND)
- KV : TIME CYCLE VALVE
- PDSH : DIFFERENTIAL PRESSURE SWITCH HIGH
- PDAH : DIFFERENTIAL PRESSURE ALARM HIGH
- FV : FLOW VALVE
- FC : FLOW CONTROLLER

NOTES

1. 1" PIPING AND VALVES FROM REGENERANT TANK TO IRON FILTER SUPPLIED BY VENDOR.

REVISIONS • BY • DATE	REVISIONS • BY • DATE

Brown & Root, Inc.

Engineers - Constructors

HOUSTON, TEXAS

DRAWN BY: G.W.C. DATE 12-10-80

CHK'D BY: A.K. DATE 2/14/81

SCALE: NONE

APPROVED

APPROVED

STATE OF TEXAS 45557 REGISTERED GARY W. LENLEY PROFESSIONAL ENGINEER SEAL

CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS

REVISED

APPROVED

DESIGN ENGINEER — MANAGER, ENGINEERING

SANITARY SEWER ENG. — QUALITY WATER ENG.

PAVING ENGINEER — STORM SEWER ENGINEER

BRIDGE ENGINEER — CONSTRUCTION ENG.

ASSISTANT DIRECTOR — DIRECTOR

TITLE OF DRAWING: PUMP STATION/MAINT. AREA - FLOW DIAGRAMS

POTABLE WATER SYSTEM

NAME OF OWNER: CITY OF HOUSTON

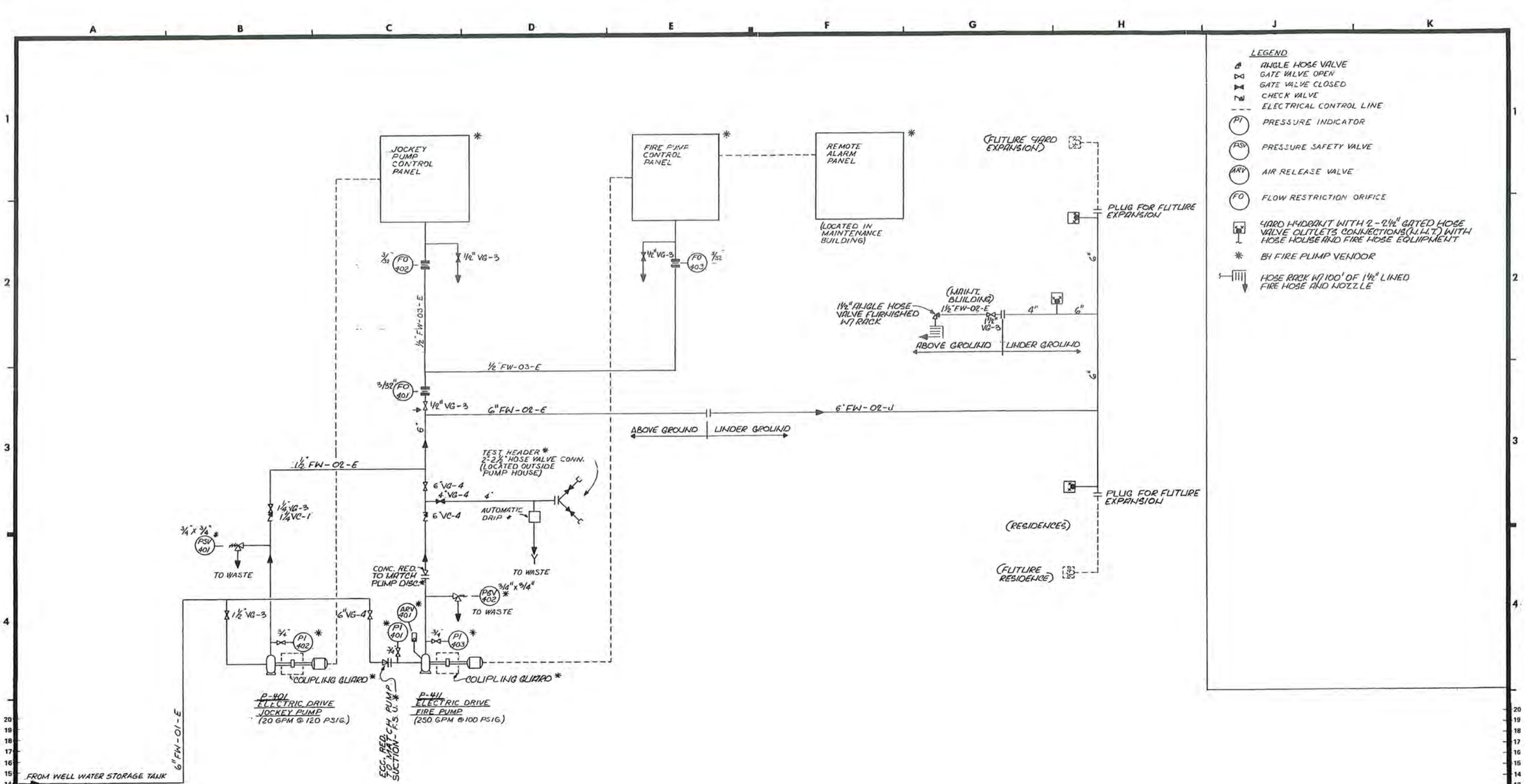
LOCATION OF PROJECT: LUCE BAYOU LIBERTY CO. TEXAS

CONTRACT NO. LBD - 200

DRAWING NO. MF-200-03

SHEET 48 OF

FORM NO. EF-000-64 21-0



CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS

REVIEWED

DESIGN ENGINEER — MANAGER, ENGINEERING

APPROVED

SANITARY SEWER ENG. — QUALITY WATER ENG.

PAVING ENGINEER — STORM SEWER ENGINEER

BRIDGE ENGINEER — CONSTRUCTION ENG.

ASSISTANT DIRECTOR — DIRECTOR

NOTES

REVISIONS • BY • DATE	REVISIONS • BY • DATE

Brown & Root, Inc.
Engineers • Consultants
HOUSTON, TEXAS

DRAWN BY: ALD.
DATE 11-20-80
CHK'D BY: A.K.
DATE 7/14/81
SCALE NONE

APPROVED

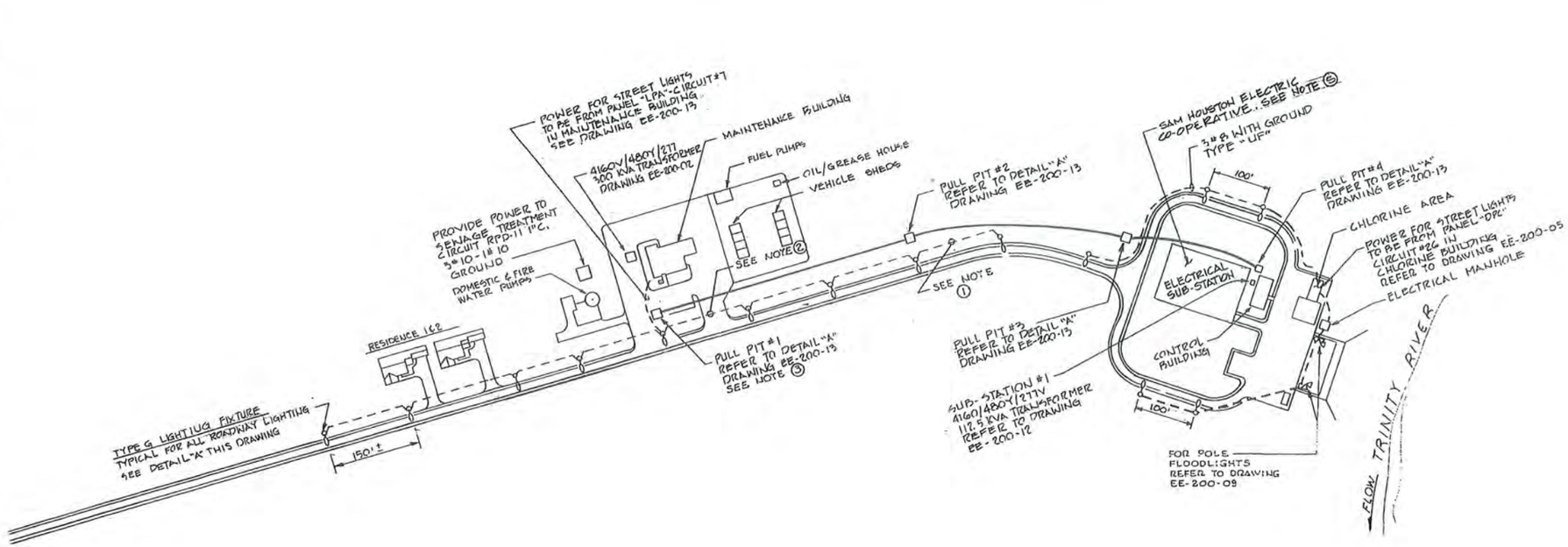
APPROVED

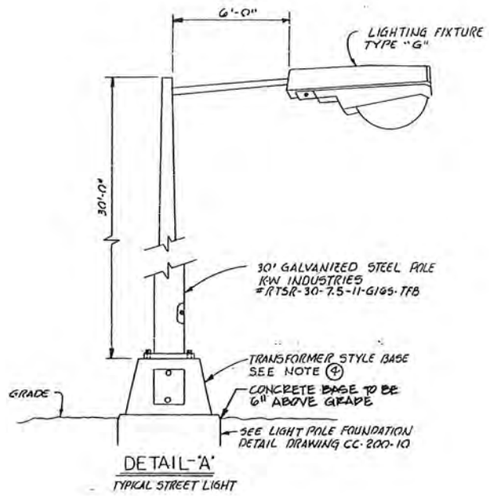
STATE OF TEXAS — GARY W. LEMLEY — 45987 — REGISTERED PROFESSIONAL ENGINEER — SEAL

TITLE OF DRAWING: PUMP STATION/MAINT. AREA - FLOW DIAGRAMS
FIRE WATER SYSTEM
NAME OF OWNER: CITY OF HOUSTON
LOCATION OF PROJECT: LUCE BAYOU LIBERTY CO. TEXAS

CONTRACT NO. LBD-200
DRAWING NO. MF-200-04
SHEET 49 OF

FORM NO. EF-000-54 21-0





DETAIL-"A"
TYPICAL STREET LIGHT

PLAN NOTES

(1) UNDERGROUND POWER ROUTING SHOWN ON THIS PLAN FOR STREET AND AREA LIGHTING TO BE 3/C #8 EHN "UF" CABLE WITH GROUND

(2) "UF" CABLE TO BE SLEEVED WITH 2" RIGID GALVANIZED STEEL CONDUIT THROUGH CONCRETE AND ASPHALT AREAS

(3) CONTRACTOR TO LOCATE PULL PIT #'S 1, 2, 3 AND 4 AS REQUIRED - REFER TO DRAWING EE-200-13 AT OR NEAR LOCATION SHOWN

(4) TRANSFORMER TYPE BASE IS FOR BETTER ACCESSABILITY ONLY. BOTH FLOODLIGHTS AND STREET LIGHT POLES ARE TO BE PROTECTED W/BUSS IN LINE FUSES #HEX-A-W-RYC OR EQUAL

(5) THE INCOMING POWER TRANSMISSION LINE AND ELECTRICAL SUB-STATION FURNISHED AND INSTALLED BY SAM HOUSTON ELECTRIC CO-OPERATIVE.

ALTERNATE NO. 1
OMIT ALL POWER, CONTROL AND INSTRUMENTATION WIRING, AND EXPOSED CONDUIT AND TERMINAL BOXES ASSOCIATED WITH PUMP P-107. THE MOTOR STARTER AND ALL EMBEDDED CONDUIT REQUIRED FOR PUMP P-107 WILL REMAIN IN THE CONTRACT. ALL EMBEDDED CONDUIT RISING THROUGH A FLOOR SHALL BE TERMINATED WITH A COUPLING AND A RECESSED PLUG, EQUAL TO THE CROUSE-HINES, TYPE PLG, SET FLUSH WITH THE FLOOR.

ALTERNATE NO. 2
SAME AS ALTERNATE NO. 1 EXCEPT IT WILL BE FOR PUMPS P-106 AND P-107.

ALTERNATE NO. 3
SAME AS ALTERNATE NO. 1 EXCEPT IT WILL BE FOR PUMPS P-105, P-106 AND P-107.

CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS
REVIEWED
DESIGN & CHECK — MANAGER, ENGINEERING
APPROVED
SANITARY SEWER ENG. — QUALITY WATER ENG.
PAVING ENGINEER — STORM SEWER ENGINEER
BRIDGE ENGINEER — CONSTRUCTION ENG.
ASSISTANT DIRECTOR — DIRECTOR

NOTES

REVISIONS	BY	DATE	REVISIONS	BY	DATE

Brown & Root, Inc.
Engineers - Consultants
HOUSTON, TEXAS

DRAWN BY: Polly Deckert
DATE 12-9-80
CHKD BY: (INITIALS)
DATE 5-15-81
SCALE: 1"=100'-0"

APPROVED

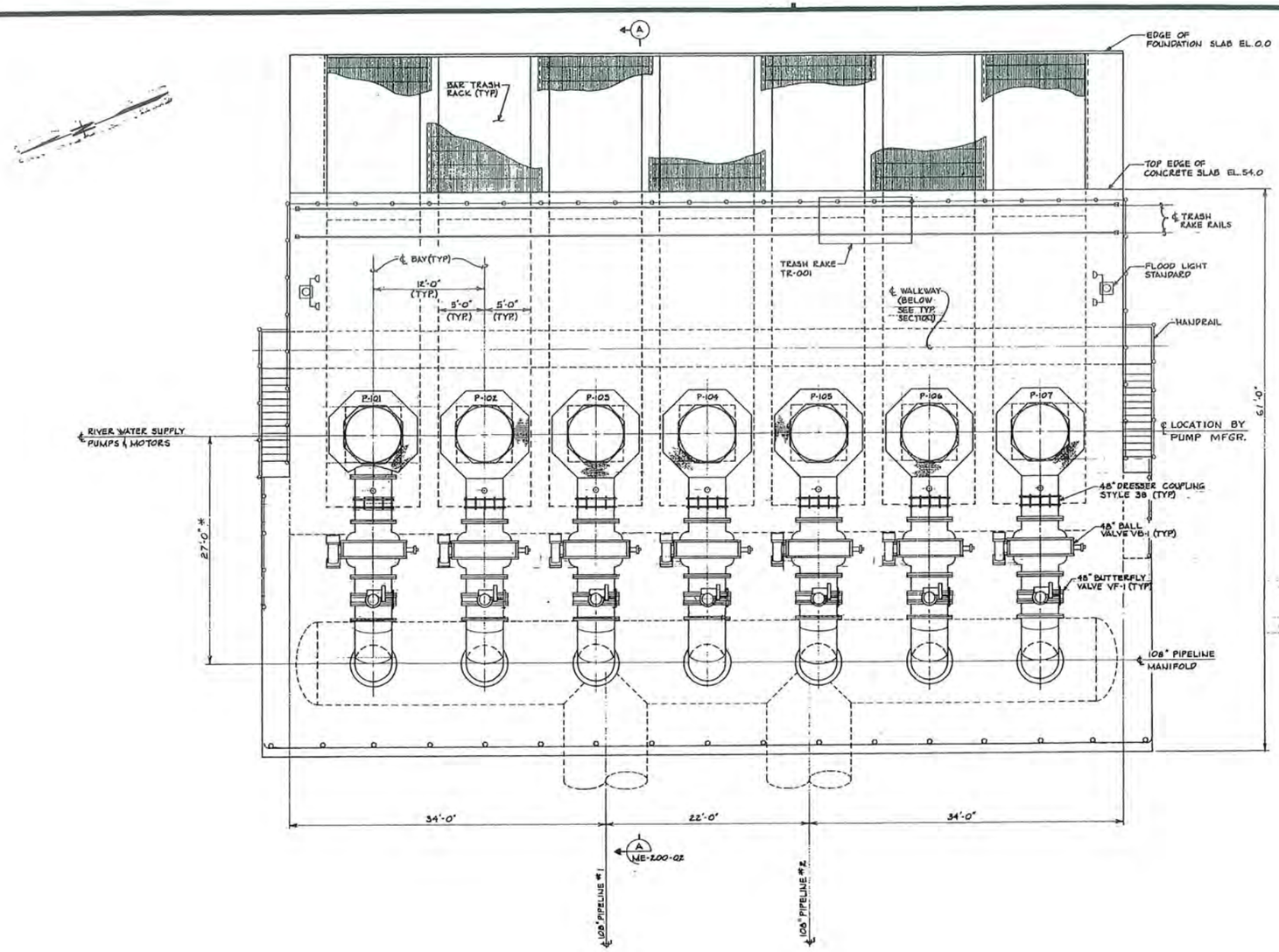
APPROVED

STATE OF TEXAS — DAVID RAY CONNELL — 43553 — REGISTERED PROFESSIONAL ENGINEER — SEAL

TITLE OF DRAWING: PUMP STATION / MAINT AREA - ELECTRICAL PLOT PLAN
NAME OF OWNER: CITY OF HOUSTON, TEXAS
LOCATION OF PROJECT: LUCE BAYOU LIBERTY, CO.

CONTRACT NO. LBD-200
DRAWING NO. EE-200-01
SHEET 50 OF

NEW LOGO 4-80
80-8527



NOTES: 1) THE CONTRACT PROPOSAL PROVIDES FOR THE INSTALLATION OF ALL SEVEN (7) PUMPS WITH MOTORS. ONE OF THREE ALTERNATES MAY, HOWEVER, BE SPECIFIED BY THE OWNER. THESE THREE ALTERNATES ARE AS FOLLOWS:
ALTERNATE NO. 1
DELETE INSTALLATION AND TESTING OF PUMP AND MOTOR P-107.
ALTERNATE NO. 2
DELETE INSTALLATION AND TESTING OF PUMP AND MOTOR P-107 AND P-106.
ALTERNATE NO. 3
DELETE INSTALLATION AND TESTING OF PUMP AND MOTOR P-107, P-106, AND P-105.

* ACTUAL DIMENSIONS TO BE DETERMINED BY PUMP MANUFACTURER.

CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS
REVIEWED
APPROVED

NOTES

REVISIONS	BY	DATE

REVISIONS	BY	DATE

Brown & Root, Inc.
Engineers - Consultants
HOUSTON, TEXAS

DRAWN BY: JAN LUFFORD
DATE 12-12-80
CHKD BY Bailey
DATE 2-15-81
SCALE 3/16" = 1'-0"

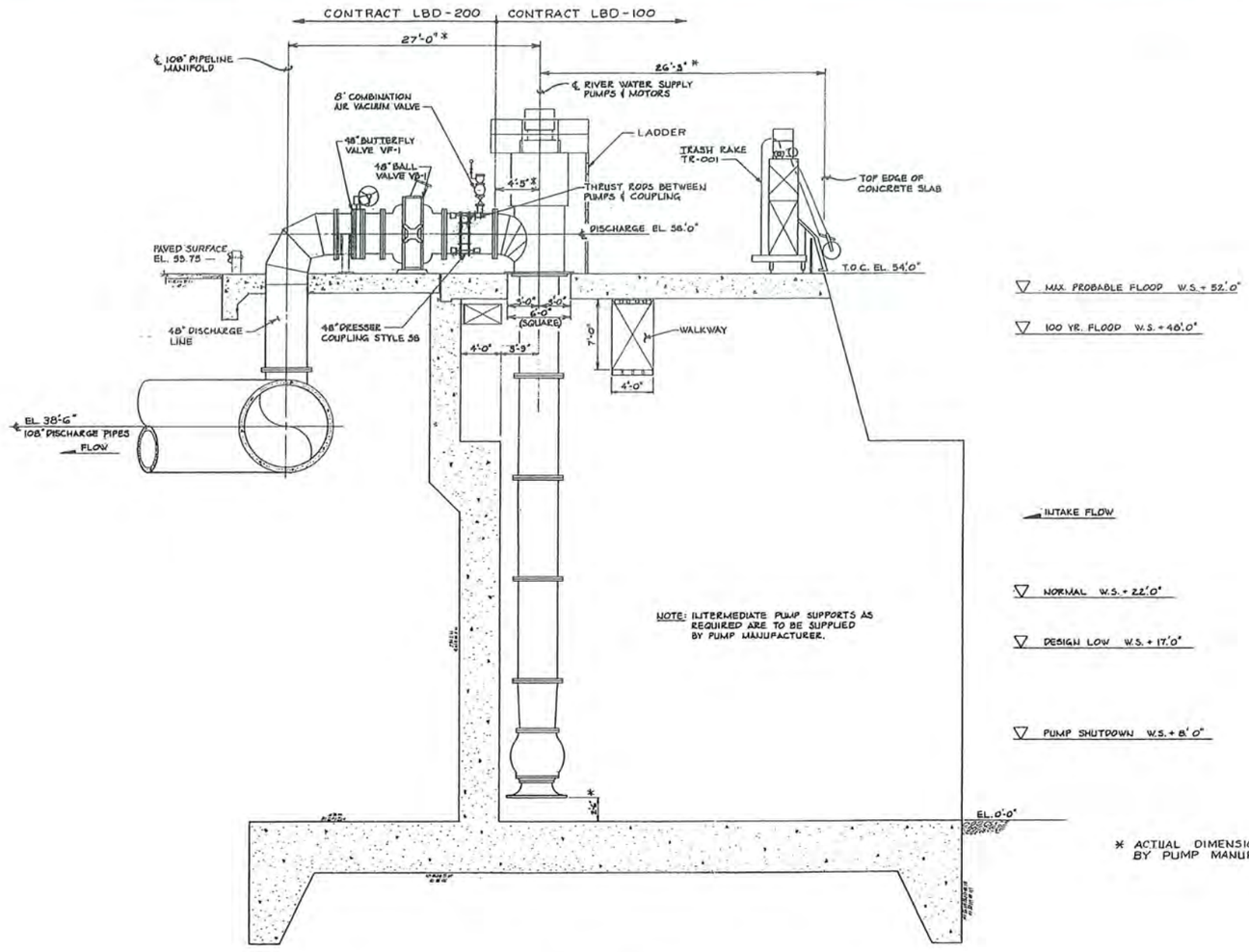
APPROVED

APPROVED

STATE OF TEXAS — GARY W. LEMLEY — 45987 — REGISTERED PROFESSIONAL ENGINEER — SEAL

TITLE OF DRAWING: PUMP STATION - MECHANICAL
MECH. EQUIPMENT LAYOUT PLAN
NAME OF OWNER: CITY OF HOUSTON
LOCATION OF PROJECT: LUCE BAYOU, LIBERTY CO., TEXAS

CONTRACT NO. LBD - 200
DRAWING NO. ME-200-01
SHEET 85 OF



SECTION A-A

CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS
REVIEWED
APPROVED

NOTES

REVISIONS	BY	DATE

REVISIONS	BY	DATE

Brown & Root, Inc.
Engineers · Consultants
HOUSTON, TEXAS

DRAWN BY: E. ALLIPSOED
DATE: 12-15-80
CHECKED BY:
DATE: 2-15-81
SCALE: 3/16" = 1'-0"

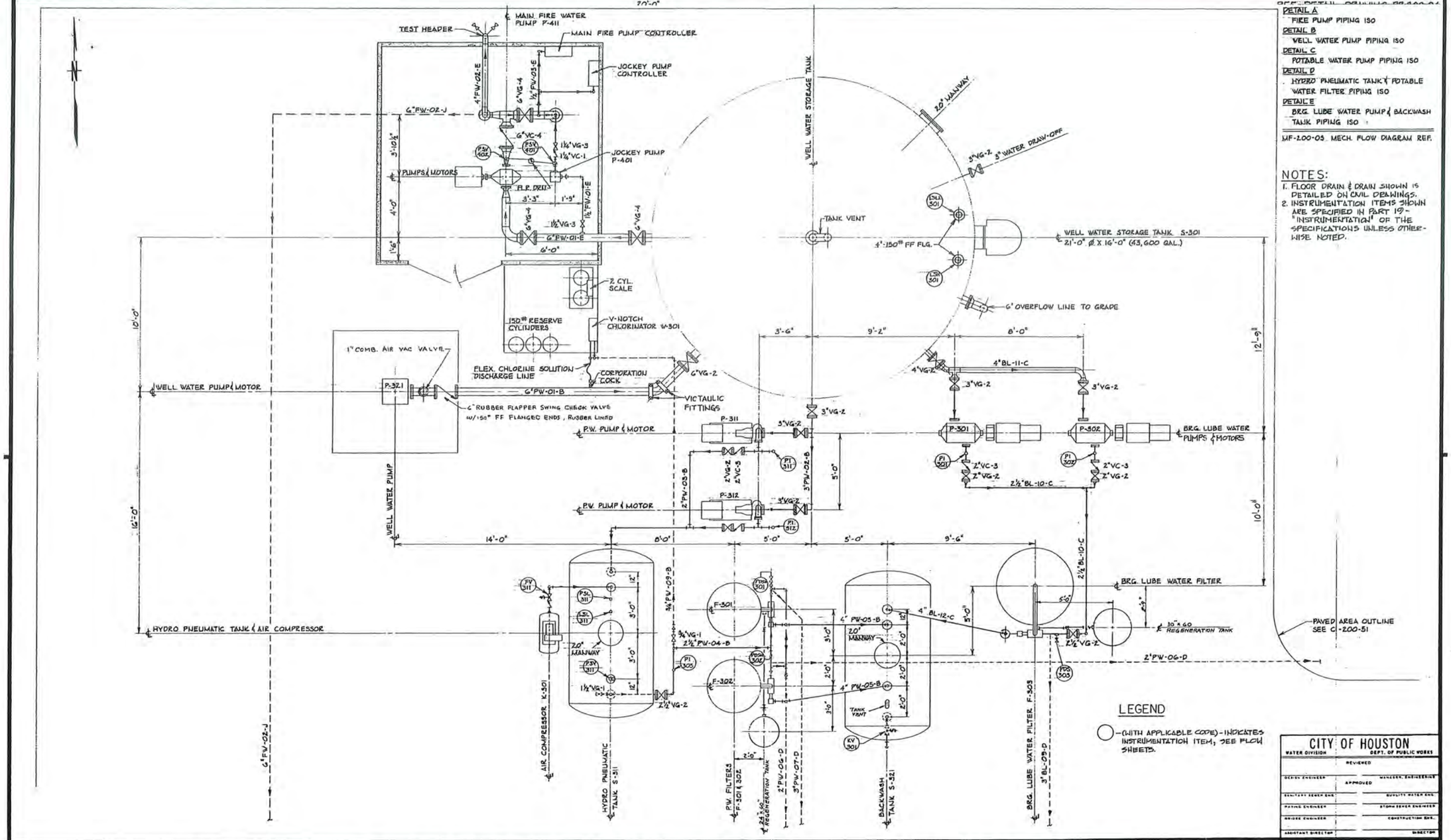
APPROVED

APPROVED

STATE OF TEXAS — GARY W. LEMLEY — 45987 — REGISTERED PROFESSIONAL ENGINEER — SEAL

TITLE OF DRAWING: PUMP STATION - MECHANICAL
MECH. EQUIPMENT LAYOUT SECTION
NAME OF OWNER: CITY OF HOUSTON
LOCATION OF PROJECT: LUCE BAYOU, LIBERTY CO., TEXAS

CONTRACT NO. LBD-200
DRAWING NO. ME-200-02
SHEET 86 OF



DETAIL A
FIRE PUMP PIPING ISO

DETAIL B
WELL WATER PUMP PIPING ISO

DETAIL C
POTABLE WATER PUMP PIPING ISO

DETAIL D
HYDRO PNEUMATIC TANK & POTABLE WATER FILTER PIPING ISO

DETAIL E
BRG. LUBE WATER PUMP & BACKWASH TANK PIPING ISO

MF-200-03 MECH. FLOW DIAGRAM REF.

NOTES:

1. FLOOR DRAIN & DRAIN SHOWN IS DETAILED ON CIVIL DRAWINGS.
2. INSTRUMENTATION ITEMS SHOWN ARE SPECIFIED IN PART 19 - "INSTRUMENTATION" OF THE SPECIFICATIONS UNLESS OTHERWISE NOTED.

LEGEND

○ -(WITH APPLICABLE CODE)- INDICATES INSTRUMENTATION ITEM; SEE FLOW SHEETS.

CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS

	REVIEWED		
DESIGN ENGINEER	APPROVED	MANAGER, ENGINEERING	
SANITARY SEWER ENG.		SUPPLY WATER ENG.	
PAVING ENGINEER		STORM SEWER ENGINEER	
BRIDGE ENGINEER		CONSTRUCTION ENG.	
ASSISTANT DIRECTOR		DIRECTOR	

NOTES
1. FOR CONTINUATION OF ALL UNDERGROUND LINES SHOWN SEE PP-200-01.
2. ALL UNDERGROUND STEEL PIPING TO BE POPED & WRAPPED.

REVISIONS	BY	DATE	REVISIONS	BY	DATE

Brown & Root, Inc.
Engineers - Consultants
HOUSTON, TEXAS

DRAWN BY: S.U. LIPSCOMB
DATE 2-13-81
CHK'D BY: J.J.O.
DATE 2-27-81
SCALE 3/8" = 1'-0"

APPROVED
APPROVED

GARY W. LEWLEY 61947 LICENSED PROFESSIONAL ENGINEER — SEAL

TITLE OF DRAWING: MAINTENANCE AREA - PIPING
POTABLE WATER GENERAL ARRANGEMENT
NAME OF OWNER: CITY OF HOUSTON
LOCATION OF PROJECT: LUCE BAYOU, LIBERTY CO., TEXAS

CONTRACT NO. LBD-200
DRAWING NO. PP-200-03
SHEET 101 OF

NEW LOBO 4-69 BA-87ST

FOR CONTINUATION SEE PP-200-05

1" CHLORINE VENT TO OUTSIDE ATMOSPHERE WITH VENT SCREEN ON OUTER END TURNED DOWN. SEE NOTE 1.

1"CL-04-(PVC) HEADER

GUARD POST (SEE DWG AA-02)

STL. PIPE & FITTINGS POLYPROPYLENE LINED

POLYPROPYLENE PIPE & FITTINGS TO BE USED TO INTERCONNECT CHLORINE & RAW WATER BELOW GRADE PIPING WITH TRENCH PIPING

6"CS-08-G

6"RW-01-C

STL. PIPE & FITTINGS POLYPROPYLENE LINED

6"CS-08-G

3"CS-08-G (TYP 7)

6"RW-01-C

1"CL-04-(PVC) (TYP-7)

PI (TYP 7)

CHLORINATORS SEE ES V-800 (TYP-7)

¼"CL-04-(PVC) (TYP-7)

Z-201 Z-202 Z-203 Z-204 Z-205 Z-206 Z-207

PCV (TYP-7)

PI

1"CHLORINE GAS FILTER

EVAPORATORS SERIES 50-202 (TYP-7)

1"GAS OUTLET CONNECTION

1"VENT CONNECTION W-101 W-101

CHLORINE ANALYZERS

SEE PP-200-08 DETAIL "B"

1"LIQUID INLET

TRENCH

2"BL-08-C

1"OVERFLOW DRAIN

½" WATER SUPPLY

1"CL-01-E

1"CL-02-E

1" WATER VAPOR VENT TO OUTSIDE ATMOSPHERE WITH VENT SCREEN ON OUTER END TURNED DOWN.

HVAC VERTICAL DUCT SEE AC-200-04

1"CL-03-(PVC) HEADER

5'-0"

6 SPACES @ 3'-0" = 18'-0"

A PP-08

HVAC VERTICAL DUCT SEE AC-200-04

CHLORINATION BUILDING

18'-0" INSIDE

7'-6" 2'-6" TRENCH 4'-0" 1'-0"

6'-6"

15'-3"

15'-6"

7'-9"

SAMPLE WATER

SAMPLE WATER

2"BL-08-D

¾" EW-02 COPPER TUBING

¾" EW-03 COPPER TUBING

FOR CONTINUATION SEE PP-200-02

I

I

TON CONTAINER #3

TON CONTAINER #2

TON CONTAINER #1

MONORAIL

PR. GAUGE

SEE PP-200-09 DET. E FOR TON CONTAINER PIPING (TYP.)

1"CL-01-E

G PP-09

TRAILER TANK #1

CHLORINE LIQUID PR. RELIEF SYSTEM

C PP-09

F PP-09

PR. GAUGE

PR. GAUGE

TRAILER TANK #2

G PP-09

OUTSIDE EDGE OF CONCRETE SLAB

CHLORINATION STORAGE TANK AREA

45'-0"

LEGEND

(PCV) – PRESSURE CONTROL VALVE

(PI) – PRESSURE INDICATOR

CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS

REVIEWED

DESIGN ENGINEER — MANAGER, ENGINEERING

APPROVED

SANITARY SEWER ENG. — QUALITY WATER ENG.

PAVING ENGINEER — STORM SEWER ENGINEER

BRIDGE ENGINEER — CONSTRUCTION ENG.

ASSISTANT DIRECTOR — DIRECTOR

NOTES

1. THE VENT LINES MUST TERMINATE IN AN AREA WHERE GAS FUMES CANNOT CAUSE DAMAGE OR INJURY TO PERSONNEL.
2. ALL VALVES REQUIRED FOR CHLORINE LIQUID OR GAS LINE TO BE SUPPLIED BY CHLORINE EQUIPMENT SUPPLIER.
3. ALL PIPING & EQUIPMENT SUPPORTS FURNISHED AND INSTALLED WHERE NECESSARY BY CONTRACTOR.

REVISIONS	BY	DATE	REVISIONS	BY	DATE

Brown & Root, Inc.
Engineers · Consultants
HOUSTON, TEXAS

DRAWN BY: J.N. LIFFORD
DATE 1-6-81
CHK'D BY: JJG
DATE 2-26-81
SCALE 3/8" = 1'-0"

APPROVED

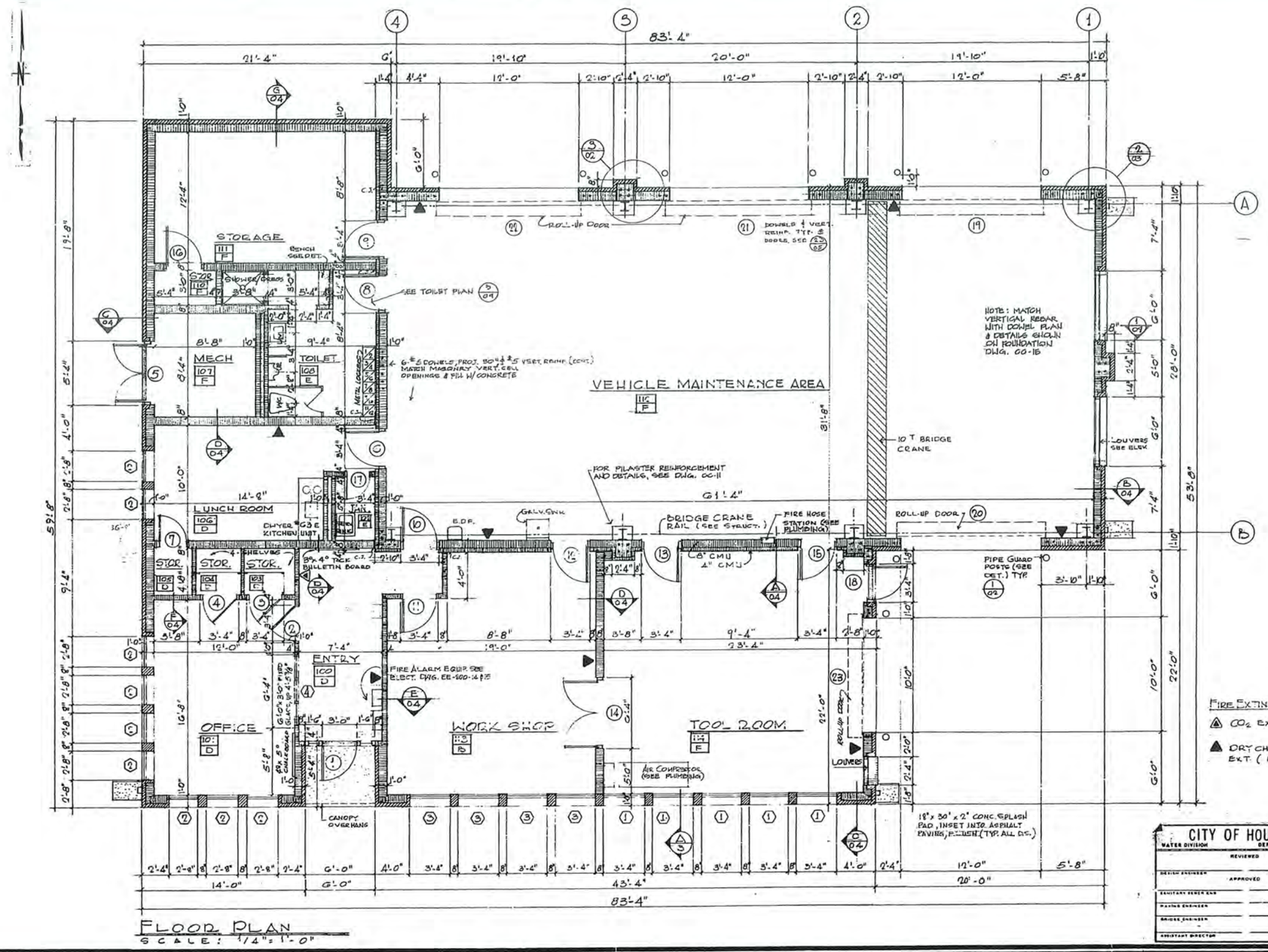
APPROVED

STATE OF TEXAS — GARY W. LENLEY — 45567 — REGISTERED PROFESSIONAL ENGINEER — SEAL

TITLE OF DRAWING: PUMP STATION - PIPING
CHLORINATION BUILDING & EQUIPMENT PLAN
NAME OF OWNER: CITY OF HOUSTON
LOCATION OF PROJECT: LUCE BAYOU, LIBERTY CO., TEXAS

CONTRACT NO. LBD-200
DRAWING NO. PP-200-07
SHEET 105 OF

FOR CONTINUATION SEE PP-200-02



FLOOR PLAN
SCALE: 1/4" = 1'-0"

CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS
REVIEWED
APPROVED

NOTES

REVISIONS	BY	DATE

REVISIONS	BY	DATE

Brown & Root, Inc.
Engineers · Consultants
HOUSTON, TEXAS

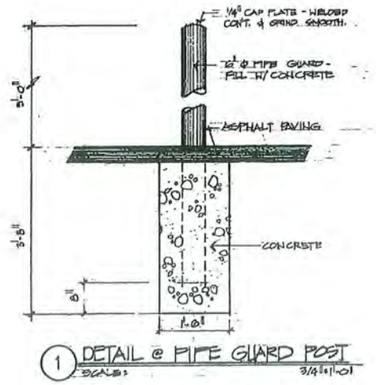
DRAWN BY: FPS
DATE 11-6-80
CHK'D BY:
DATE
SCALE:

APPROVED
APPROVED

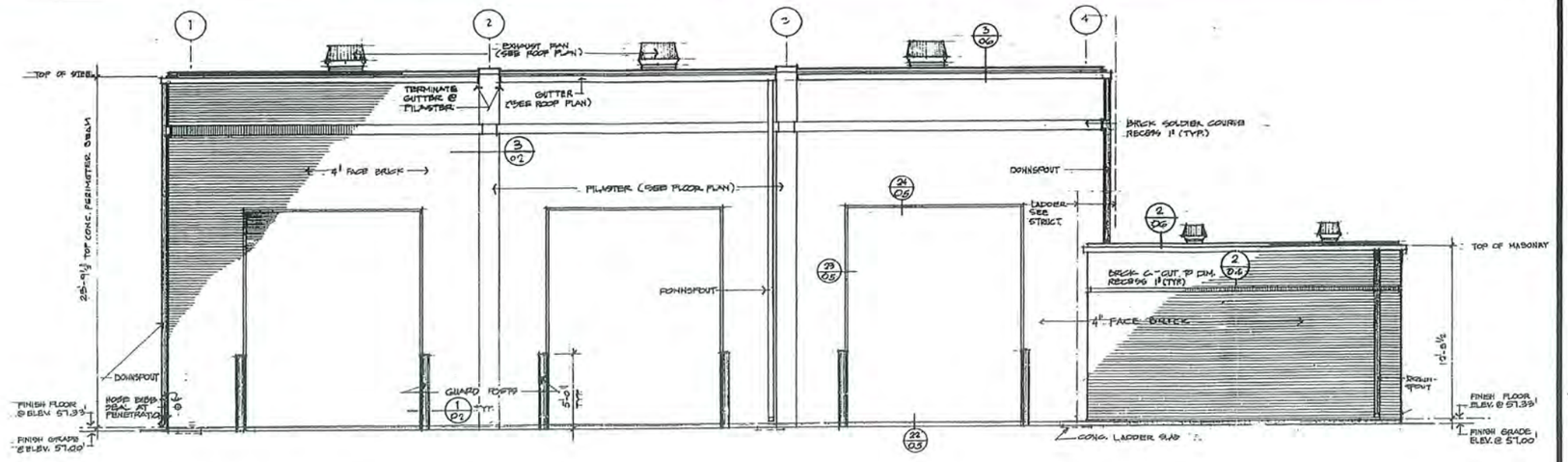
REGISTERED ARCHITECT — SEAL

TITLE OF DRAWING: MAINTENANCE AREA - ARCHITECTURAL
MAINTENANCE BUILDING PLAN
NAME OF OWNER: CITY OF HOUSTON
LOCATION OF PROJECT: LUCE BAYOU, LIBERTY CO., TEXAS

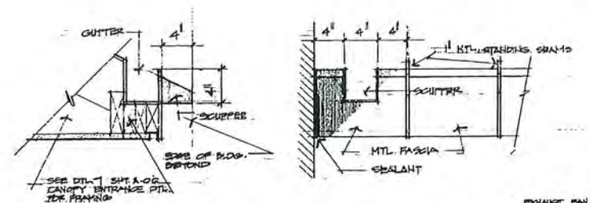
CONTRACT NO. LBD-200
DRAWING NO. AA-200-01
SHEET 110 OF



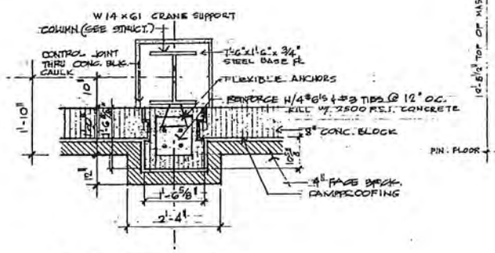
1 DETAIL @ PIPE GUARD POST
SCALE: 3/4"=1'-0"



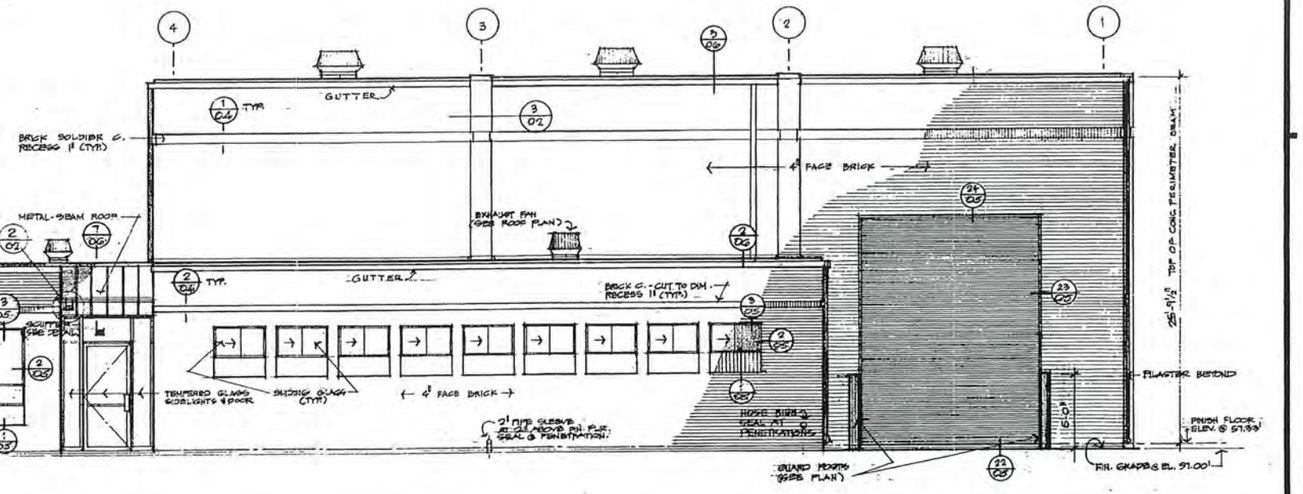
NORTH ELEVATION
SCALE: 1/4"=1'-0"



2 SCUPPER DETAILS
SCALE: 1 1/2"=1'-0"



3 PILASTER DETAIL
SCALE: 3/4"=1'-0"



SOUTH ELEVATION
SCALE: 1/4"=1'-0"

CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS
REVIEWED
DESIGN ENGINEER — MANAGER, ENGINEERING
APPROVED
SANITARY SEWER ENG. — QUALITY WATER ENG.
PAVING ENGINEER — STORM SEWER ENGINEER
BRIDGE ENGINEER — CONSTRUCTION ENG.
ASSISTANT DIRECTOR — DIRECTOR

NOTES

REVISIONS	BY	DATE

REVISIONS	BY	DATE

Brown & Root, Inc.
Engineers · Consultants
HOUSTON, TEXAS

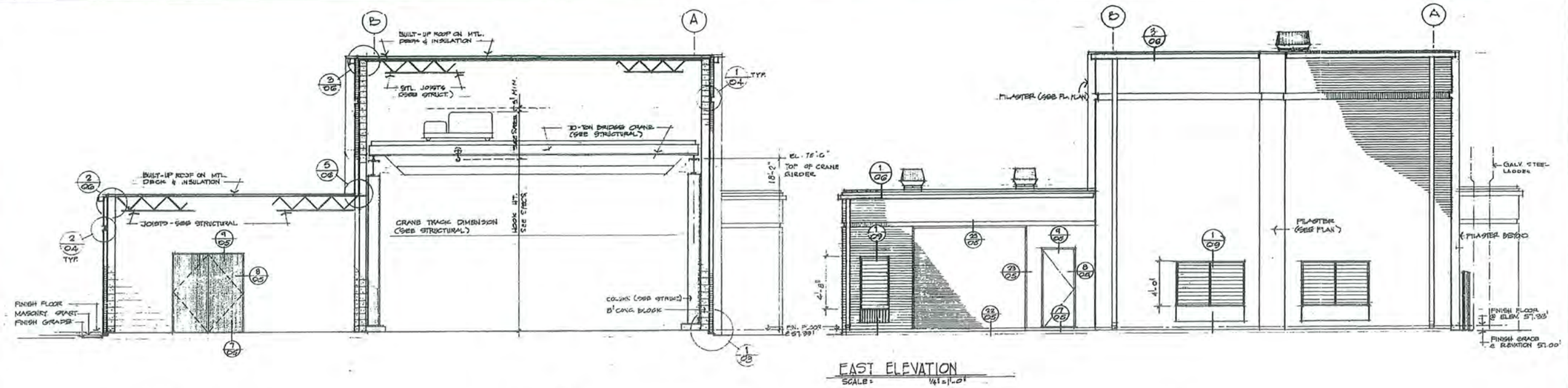
DRAWN BY: R. O'DONNELL
DATE
CHK'D BY:
DATE
SCALE: AS SHOWN

APPROVED
APPROVED

TITLE OF DRAWING: MAINTENANCE AREA ARCHITECTURAL
MAINTENANCE BLDG. ELEVATIONS SHEET 1 OF 2
NAME OF OWNER: CITY OF HOUSTON, TEXAS
LOCATION OF PROJECT: LUCE BAYOU, LIBERTY CO.

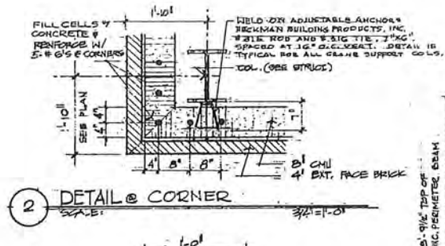
CONTRACT NO. LED-200
DRAWING NO. AA-200-02
SHEET 111 OF

521

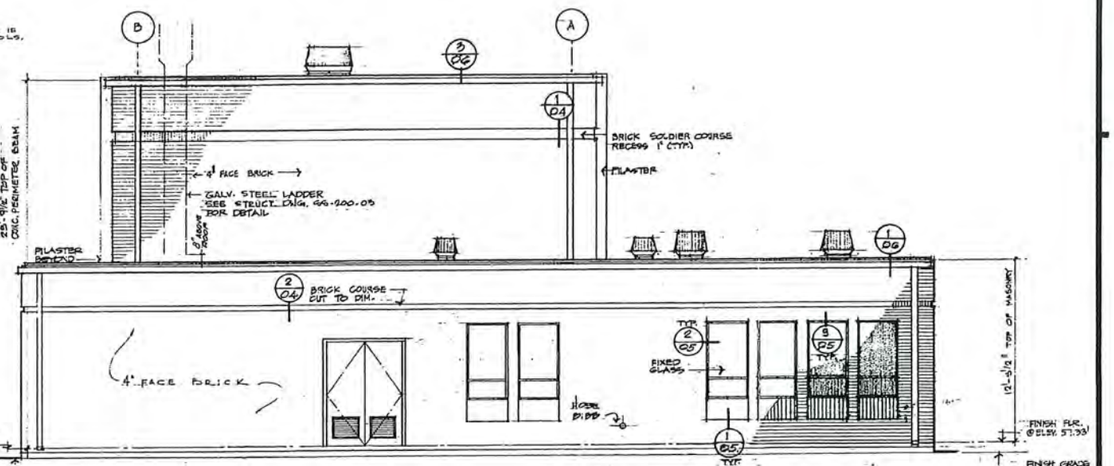


EAST ELEVATION
SCALE: 1/4" = 1'-0"

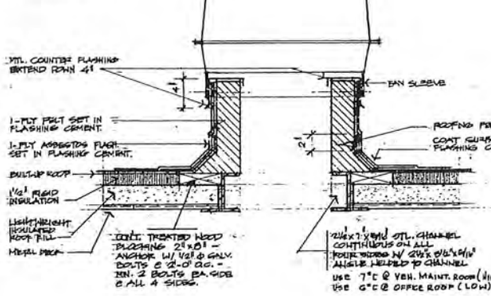
BUILDING CROSS SECTION A-A
SCALE: 1/4" = 1'-0"



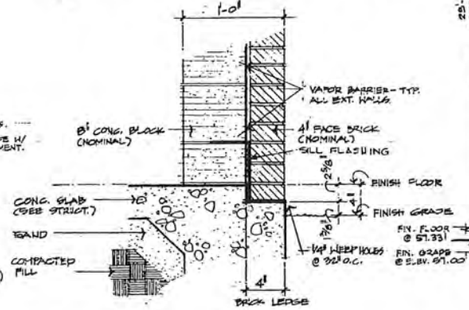
(2) DETAIL @ CORNER
SCALE: 3/4" = 1'-0"



WEST ELEVATION
SCALE: 1/4" = 1'-0"



(3) FLASHING DETAIL @ ROOF FANS
SCALE: 1 1/2" = 1'-0"



(1) DETAIL @ BRICK LEDGE
SCALE: 1 1/2" = 1'-0"

CITY OF HOUSTON — WATER DIVISION — DEPT. OF PUBLIC WORKS	
REVIEWED	
DESIGN ENGINEER	MANAGER, ENGINEERING
APPROVED	
SANITARY SEWER SUP.	QUALITY WATER ENG.
PAVING ENGINEER	STORM SEWER ENGINEER
BRIDGE ENGINEER	CONSTRUCTION ENG.
ASSISTANT DIRECTOR	DIRECTOR

NOTES

REVISIONS	BY	DATE	REVISIONS	BY	DATE

Brown & Root, Inc.
Engineers · Consultants
HOUSTON, TEXAS

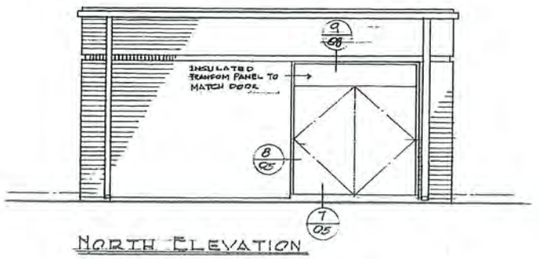
DRAWN BY: R. ODONNELL
DATE
CHK'D BY:
DATE
SCALE: AS SHOWN

APPROVED
APPROVED

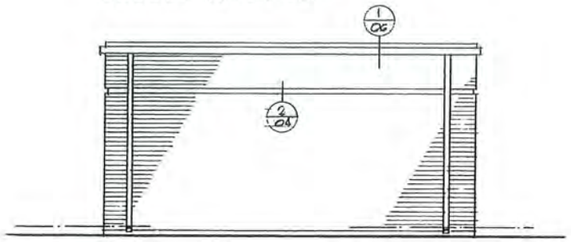
REGISTERED ARCHITECT — STATE OF TEXAS

TITLE OF DRAWING: MAINTENANCE AREA - ARCHITECTURAL
MAINTENANCE BUILDING ELEV. SHEET 2 OF 2
NAME OF OWNER: CITY OF HOUSTON, TEXAS
LOCATION OF PROJECT: LUCE BAYOU, LIBERTY CO.

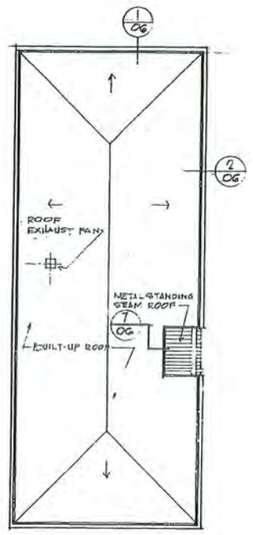
CONTRACT NO. LBD-200
DRAWING NO. AA-200-03
SHEET 112 OF



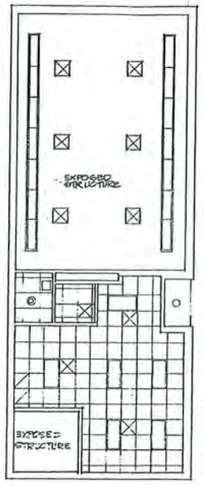
NORTH ELEVATION
SCALE: 1/4" = 1'-0"



SOUTH ELEVATION
SCALE: 1/4" = 1'-0"



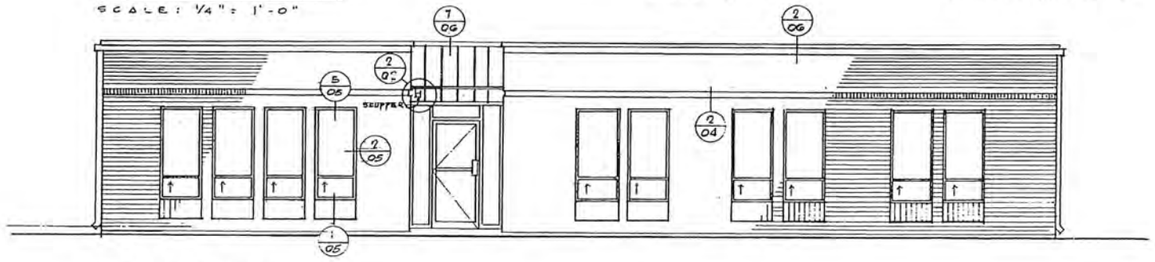
ROOF PLAN
SCALE: 1/8" = 1'-0"



REFLECTED CEILING PLAN
SCALE: 1/8" = 1'-0"

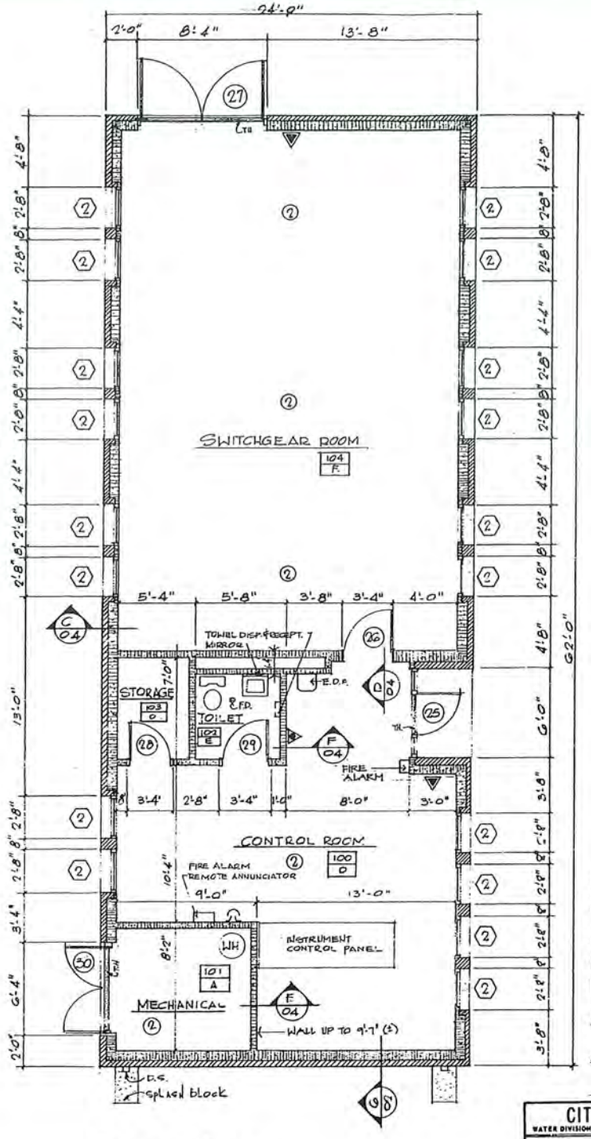
LEGEND
- FLUORESCENT LIGHT FIXTURE
- SUPPLY AIR REGISTER
- RETURN AIR GRILLE
- RECESSED LIGHT FIXTURE

FOR ELECTRICAL LIGHTING SEE DWG. EE-200-12. FOR HVAC SEE DWG. AD-200-08



EAST ELEVATION
SCALE: 1/4" = 1'-0"

WEST ELEVATION
SCALE: 1/4" = 1'-0"



FLOOR PLAN
SCALE: 1/4" = 1'-0"

FIRE PROTECTION SYMBOLS
- FIRE ALARM BELL
- (2) SMOKE DETECTOR (IONIZATION) @ CEILING
- MANUAL FIRE ALARM BOX
- WATER EXTINGUISHER (2½ #)
- CO_2 EXTINGUISHER (5 #)

CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS
REVIEWED
DESIGN ENGINEER — MANAGER, ENGINEERING
APPROVED
SANITARY SEWER ENG. — QUALITY WATER ENG.
PLANS ENGINEER — STORM SEWER ENGINEER
BRIDGE ENGINEER — CONSTRUCTION ENG.
ASSISTANT DIRECTOR — DIRECTOR

NOTES

REVISIONS	BY	DATE

REVISIONS	BY	DATE

Brown & Root, Inc.
Engineers - Consultants
HOUSTON, TEXAS

DRAWN BY: TPB
DATE: 1-5-81
CHK'D BY:
DATE:
SCALE:

APPROVED

APPROVED

REGISTERED ARCHITECT — STATE OF TEXAS

TITLE OF DRAWING: PUMP STATION - ARCHITECTURAL
CONTROL BUILDING
NAME OF OWNER: CITY OF HOUSTON, TEXAS
LOCATION OF PROJECT: LUCE BAYOU, LIBERTY CO., TEXAS

CONTRACT NO. LBD-200
DRAWING NO AA-200-08
SHEET 117 OF

ROOM FINISH SCHEDULE

MARK	FLOOR	BASE	WALLS	CEILING	HT.	REMARKS
A	CONCRETE	NONE	½" GYP. BD.	½" GYP. BD.	8'-4"	SLOPE CONC. FLOOR AS NOTED
B	SHEET VINYL	WOOD - 3½"	VINYL WALLCOVER	½" GYP. BD.	8'-0"	¼" GYP. BD. WALLS
C	SHEET VINYL	WOOD - 3½"	PAINT ½" GYP. BD	½" GYP. BD.	8'-0"	
D	CARPET	WOOD - 3½"	WOOD PANELING	½" GYP. BD.	8'-0"	
E	CARPET	WOOD - 3½"	PAINT ½" GYP. BD.	½" GYP. BD.	8'-0"	
F	CARPET	WOOD - 3½"	VINYL WALLCOVER	½" GYP. BD.	8'-0"	
G	CONCRETE	NONE	WOOD SIDING	⅜" EXT. PLYWOOD	8'-0" (-)	1¼" x 1½" BATTEN @ JOINTS
H	CERAMIC TILE	CER. TILE	PAINT ½" GYP. BD.	½" GYP. BD.	8'-0"	

PRODUCTS

CARPET - KARASTAN MADREAU, YUMA BEIGE, # 38893

WALL COVERING: a) ENTRY - FERNDALE # TEG17 # BARTON WEAVE # TR G696 ; YORK

b) KITCHEN/BREAKFAST - HATTIE # QM 807 ; YORK

c) LAUNDRY - BURLINGTON # RM 1345 ; YORK

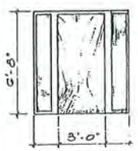
d) DRESSING #1 - LAURA ANNE # TR G692 ; YORK

e) DRESSING #2 - SHANNON # RM 1812 ; YORK

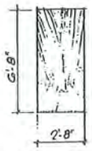
NOTE: SEE ELECTRICAL DWGS. FOR FIRE PROTECTION SYSTEM.

ROOM NAME INDICATOR

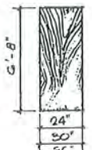
FIN. TYPE (SEE FLOOR PLAN)



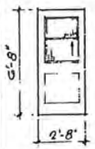
5'-0" x 6'-8" x 1 3/8" EXT. WOOD S.C. ¼" POL. P. (TEMP) GLASS — (A)



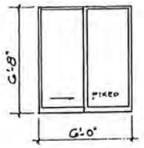
2'-8" x 6'-8" x 1¾" EXT. WOOD C.C. — (B)



1 3/8" H.C. INT. BIRCH OR F.G.

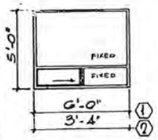


2'-8" x 6'-8" x 1¾" EXT. WOOD, PANEL, ALUM. & GLASS LOUVRE VENT. 16 M. ALUM. SCREEN — (D)

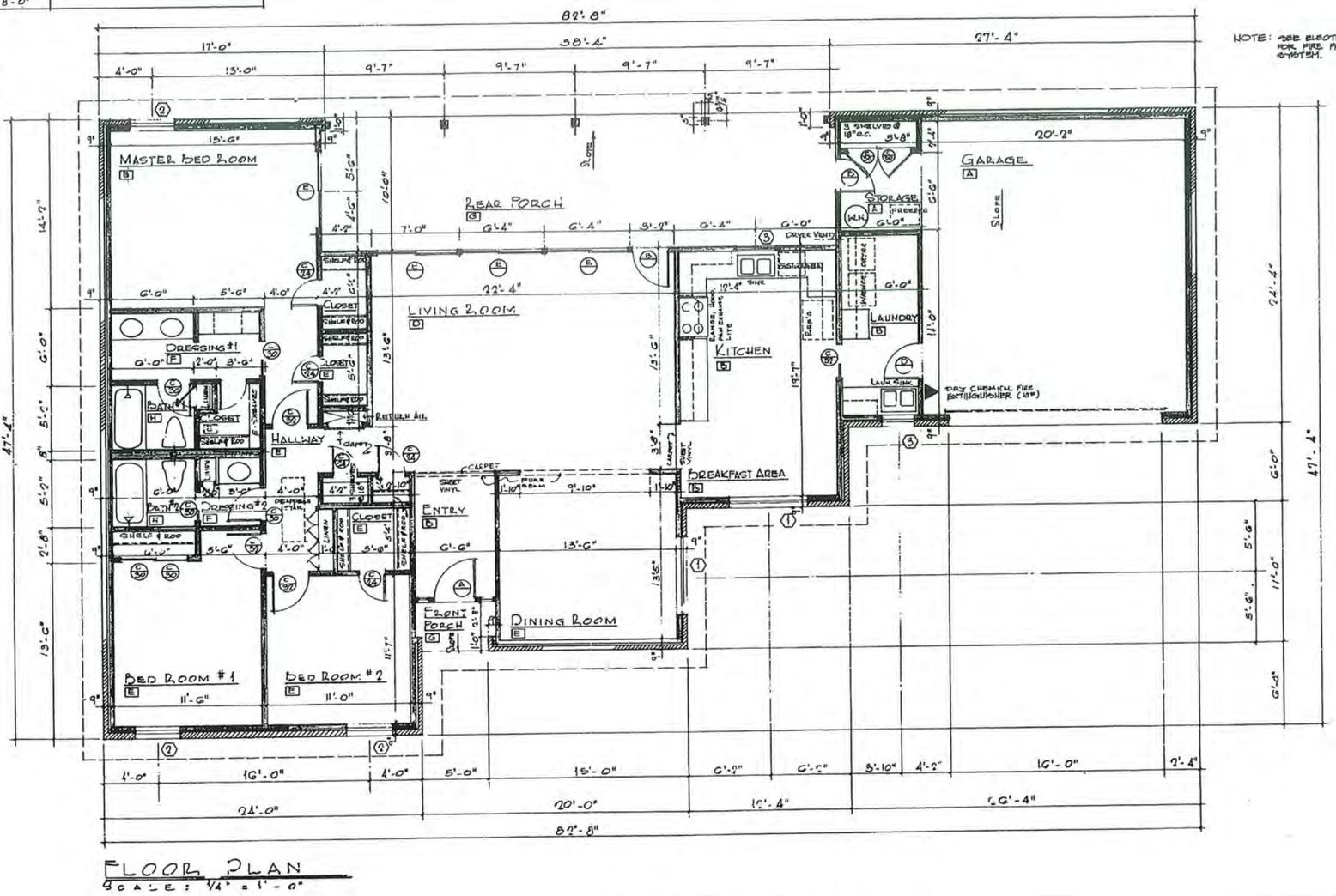


6'-0" x 6'-8" ALUM. & TEMP. ¼" POL. P. GLASS — (E)

DOOR TYPES



WINDOW TYPES



FLOOR PLAN

SCALE: ¼" = 1'-0"

NOTES

REVISIONS	BY	DATE

REVISIONS	BY	DATE

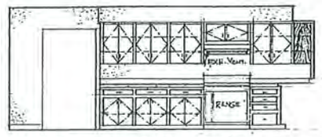
Brown & Root, Inc.
Engineers · Consultants
HOUSTON, TEXAS

DRAWN BY: FEO
DATE
CHK'D BY:
DATE
SCALE: ¼" = 1'-0"

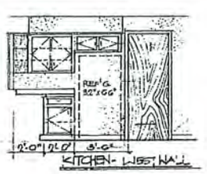
APPROVED
APPROVED

TITLE OF DRAWING: MAINTENANCE AREA - ARCHITECTURAL
RESIDENCES' FLOOR PLAN
NAME OF OWNER: CITY OF HOUSTON
LOCATION OF PROJECT: LUCE BAYOU LIBERTY CO. TEXAS

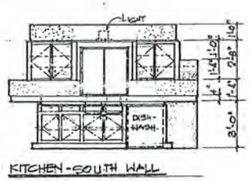
CONTRACT NO. LBD-200
DRAWING NO. AA-200-10
SHEET 119 OF



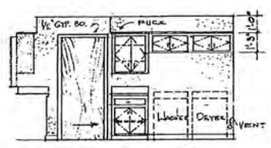
BREAKFAST - KITCHEN - EAST WALL



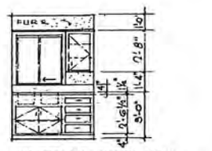
KITCHEN - WEST WALL



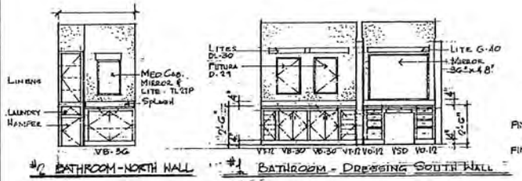
KITCHEN - SOUTH WALL



LAUNDRY ROOM - EAST WALL



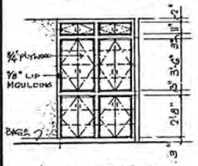
LAUNDRY RM. - NORTH WALL



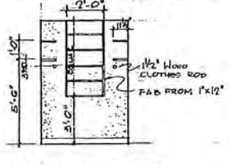
#2 BATHROOM - NORTH WALL

#1 BATHROOM - DRESSING SOUTH WALL

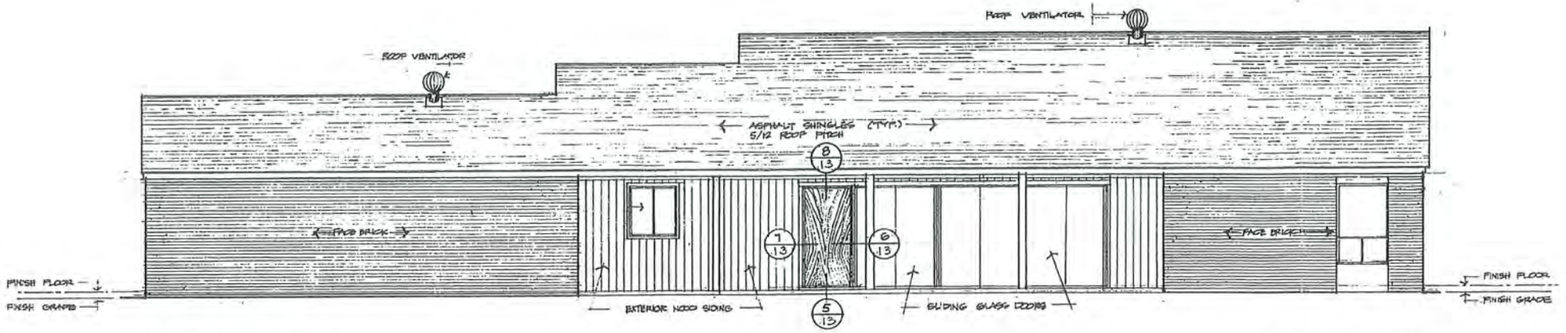
INTERIOR ELEVATIONS - CABINET DETAILS
SCALE: 1/4"=1'-0"



LINEN CLOSET

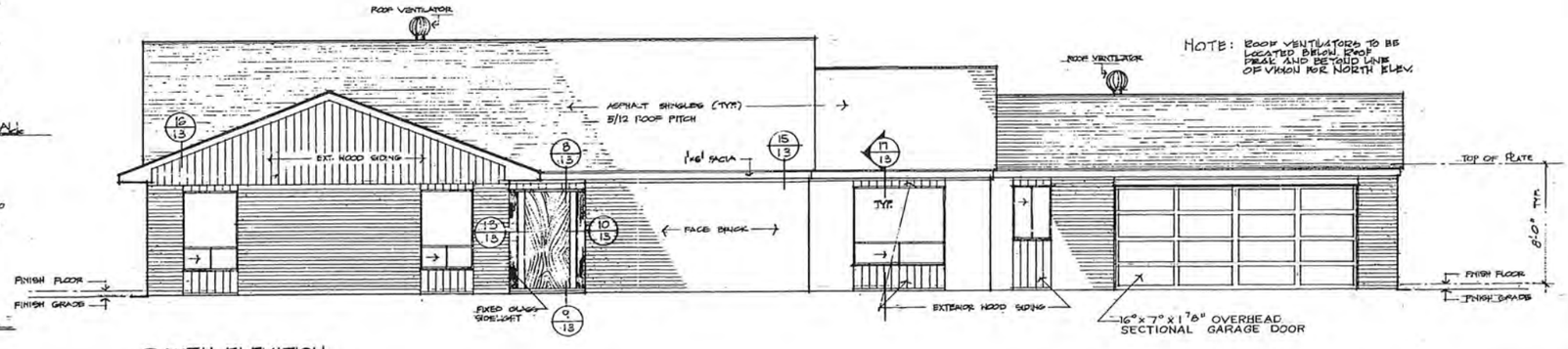


M.B.R. CLOSETS



NORTH ELEVATION
SCALE: 1/8"=1'-0"

SEE ELECTRICAL DRAWINGS FOR OUTSIDE LIGHTING



NOTE: ROOF VENTILATORS TO BE LOCATED BELOW ROOF PEAK AND BEYOND LINE OF VISION FOR NORTH ELEV.

16'x7'x1 7/8" OVERHEAD SECTIONAL GARAGE DOOR

SOUTH ELEVATION
SCALE: 1/8"=1'-0"

CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS
REVISED:
DESIGN ENGINEER — MANAGER, DISTRIBUTION
APPROVED:
SANITARY ENGINEER — SUPT. WATER DIST.
PLANS CHECKED — STORM SEWER SUPERVISOR
BRIDGE ENGINEER — CONSTRUCTION ENG.
ASSISTANT DIRECTOR — DIRECTOR

NOTES

REVISIONS	BY	DATE

REVISIONS	BY	DATE

Brown & Root, Inc.
Engineers - Consultants
HOUSTON, TEXAS

DRAWN BY: R. O'DONNELL
DATE
CHK'D BY:
DATE
SCALE: AS SHOWN

APPROVED

APPROVED

TITLE OF DRAWING: MAINTENANCE AREA - ARCHITECTURAL
RESIDENCES ELEVATIONS
NAME OF OWNER: CITY OF HOUSTON
LOCATION OF PROJECT: LUCE BAYOU, LIBERTY CO., TEXAS.

CONTRACT NO. LBD-200
DRAWING NO. AA-200-12
SHEET 121 OF

Appendix B

Section 3

PIPELINE CONVEYANCE FACILITY

CONTRACT NO. LBD-300

LUCE BAYOU DIVERSION PROJECT

WATER DIVISION PROJECT NO. 7392-3

CITY OF HOUSTON, TEXAS

MAYOR

Kathryn J. Whitmire

COUNCILMEN

Larry McKaskle	Dale Gorczynski
Ernest McGowen, Sr.	Ben T. Reyes
George Greanias	Jim Westmoreland
Rodney Ellis	Eleanor Tinsley
Frank Mancuso	Jim Greenwood
John G. Goodner	Anthony W. Hall, Jr.
Christin Hortung	Judson Robinson, Jr.

CONTROLLER

Lance Lalor

DEPT OF PUBLIC WORKS

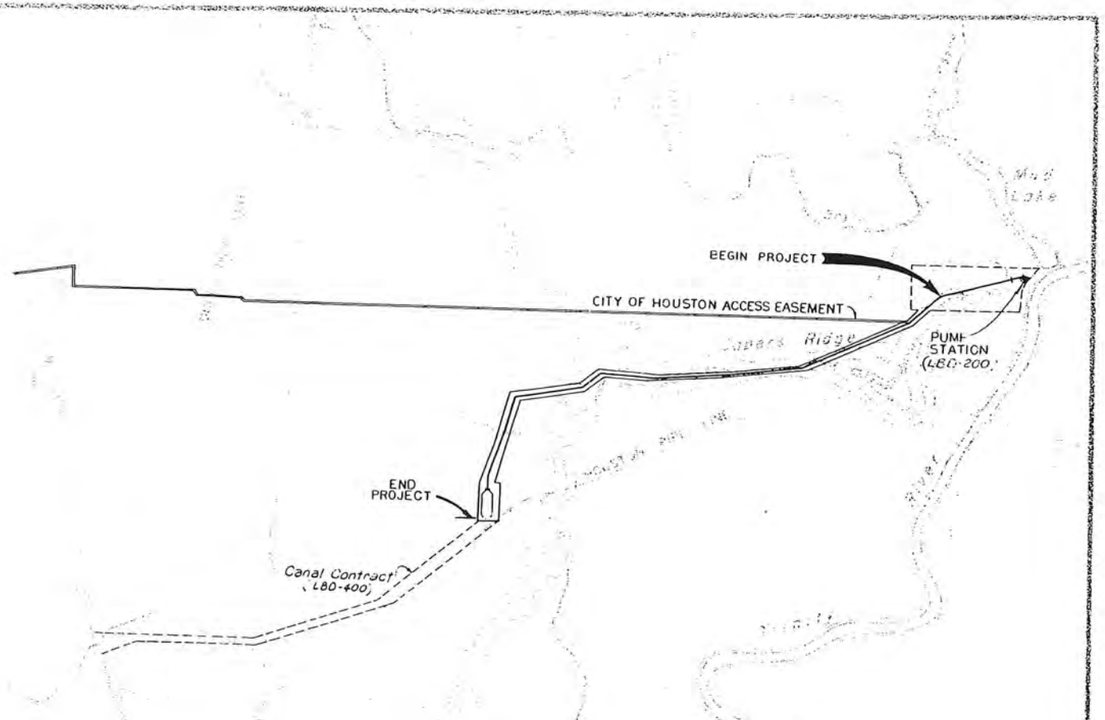
Jon C. Vanden Bosch — Director

BROWN & ROOT, INC.
ENGINEERS & CONSULTANTS

HOUSTON, TEXAS

DWG. CC-300-01

HOUSTON, TEXAS



CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS

REVIEWED

DESIGN ENGINEER — MANAGER, ENGINEERING
APPROVED
SANITARY SEWER ENG. — QUALITY WATER ENG.
PAVING ENGINEER — STORM SEWER ENGINEER
BRIDGE ENGINEER — CONSTRUCTION ENG.
ASSISTANT DIRECTOR — DIRECTOR

Brown & Root Inc
Engineers · Consultants

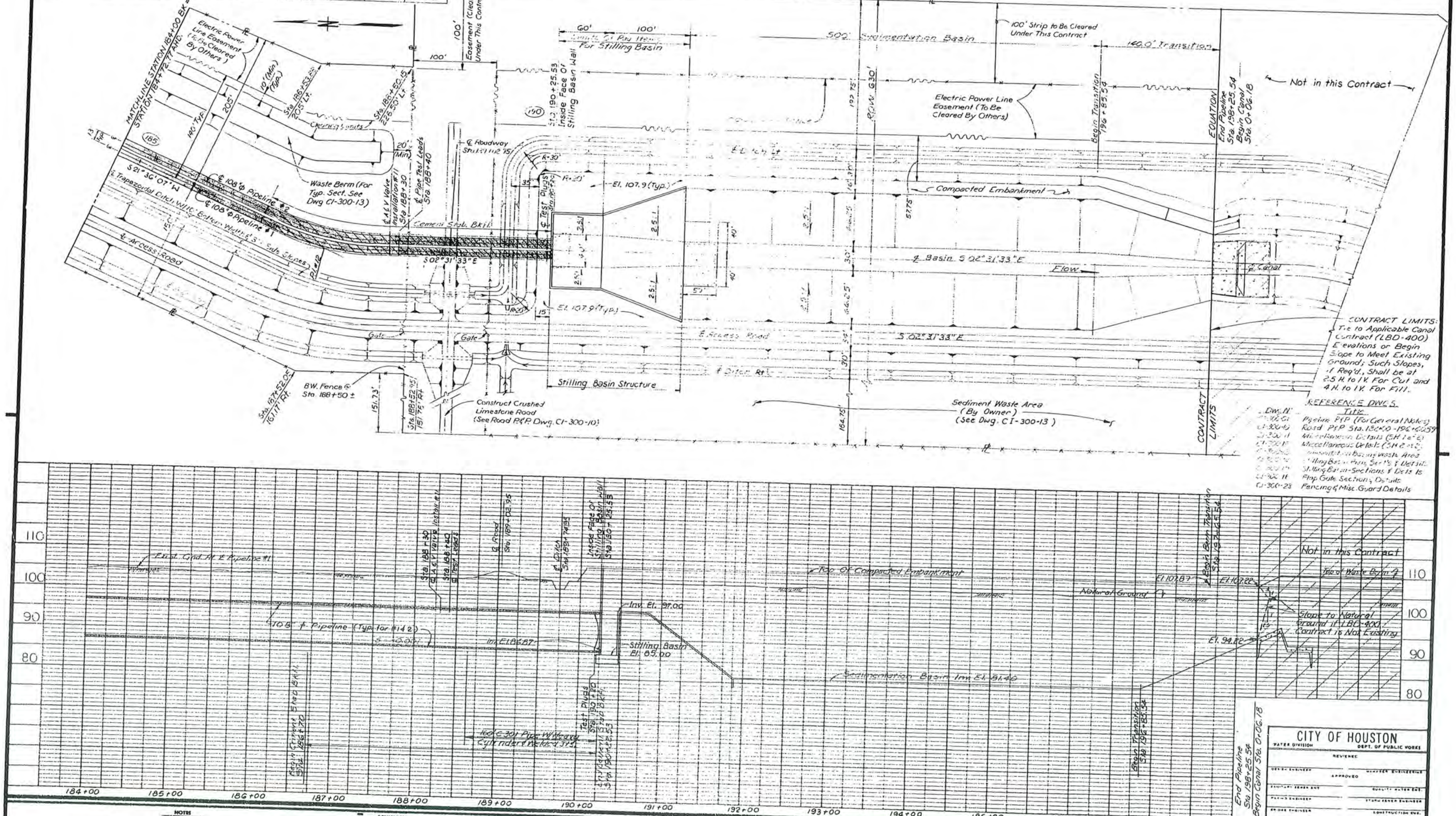
DRAWN B. Luce
DATE 7-17-81
SCALE As Shown
DATE 4-1-82

TITLE OF DRAWING: PROJECT LOCATION MAP
PIPELINE CONVEYANCE FACILITY
CITY OF HOUSTON
LOCATION OF PROJECT: LUCE BAYOU LIBERTY CO., TEXAS

CONTRACT NO. LBD-300
DRAWING NO. GG-300-03
SHEET 3 OF 26

HORIZONTAL CURVE DATA

P.I. No.	P.I. BACK	P.I. AHEAD	P.C. & P.R.C.	P.T. & P.R.C.	Δ	R	T	L	C
12	187+50.28	187+48.35	186+85.31	188+13.32	24°07'20"	303.99	64.97	128.01	127.07



MATCHLINE STATION 184+00 BK = STATION 184+12.77 AHD.
Electric Power Line Easement (To Be Cleared By Others)
Waste Berm (For Typ. Sect. See Dwg CI-300-13)
S 21°36'07" W
108" Φ Pipeline #2
108" Φ Pipeline #1
Trapezoidal Ditch With Bottom Width 3' Side Slopes
Access Road
Cement Stab. Bkfl.
S 02°31'33" E
Roadway
Test Plugs
El. 107.9 (Typ.)
500' Sedimentation Basin
100' Strip to Be Cleared Under This Contract
140.0' Transition
Not in this Contract
Electric Power Line Easement (To Be Cleared By Others)
Begin Transition Sta 196+85.54
EQUATION End Pipeline Sta 198+25.54 Begin Canal Sta 0+06.18
Compacted Embankment
Basin S 02°31'33" E
Flow
Canal
E Access Road
S 02°31'33" E
Stilling Basin Structure
BW Fence Sta 188+50 ±
Construct Crushed Limestone Road (See Road P&P Dwg. CI-300-10)
Sediment Waste Area (By Owner) (See Dwg. CI-300-13)
CONTRACT LIMITS
CONTRACT LIMITS: Tie to Applicable Canal Contract (LBD-400) Elevations or Begin Slope to Meet Existing Ground; Such Slopes, if Req'd., Shall be at 2.5 H. to 1 V. For Cut and 4 H. to 1 V. For Fill.
REFERENCE DWGS.
Pipeline P&P (For General Notes)
Road P&P Sta. 136+50 - 196+60.59
Miscellaneous Details (SH 1 of 2)
Miscellaneous Details (SH 2 of 2)
Sedimentation Basin/Waste Area
Stilling Basin Plan, Sect's & Details
Stilling Basin - Sections & Details
Pipe Gate Section & Details
CI-300-23 Fencing & Misc. Guard Details
Exist. Grnd. At Pipeline #1
Top Of Compacted Embankment
Natural Ground
Not in this Contract
Top of Waste Berm
Slope to Natural Ground if LBD-400 Contract is Not Existing
108" Pipeline (Typ. for #1 & 2)
Inv. El. 97.00
Stilling Basin El. 85.00
Sedimentation Basin Inv. El. 81.40
El. 102.87
El. 102.22
El. 94.82
Begin Cement Stab. Bkfl. Sta. 186+70
Test Plugs Sta. 190+20
Begin Berm Transition Sta 196+85.54
End Pipeline Sta 198+25.54 Begin Canal Sta. 0+06.18
110
100
90
80
184+00
185+00
186+00
187+00
188+00
189+00
190+00
191+00
192+00
193+00
194+00
195+00
196+00
197+00
198+00

NOTES

REVISIONS	BY	DATE	REVISIONS	BY	DATE

Brown & Root, Inc.
Engineers Consultants
HOUSTON, TEXAS

DRAWN BY:
DATE 12-9-80
CHK'D BY:
DATE 9-16-81
SCALE:

APPROVED

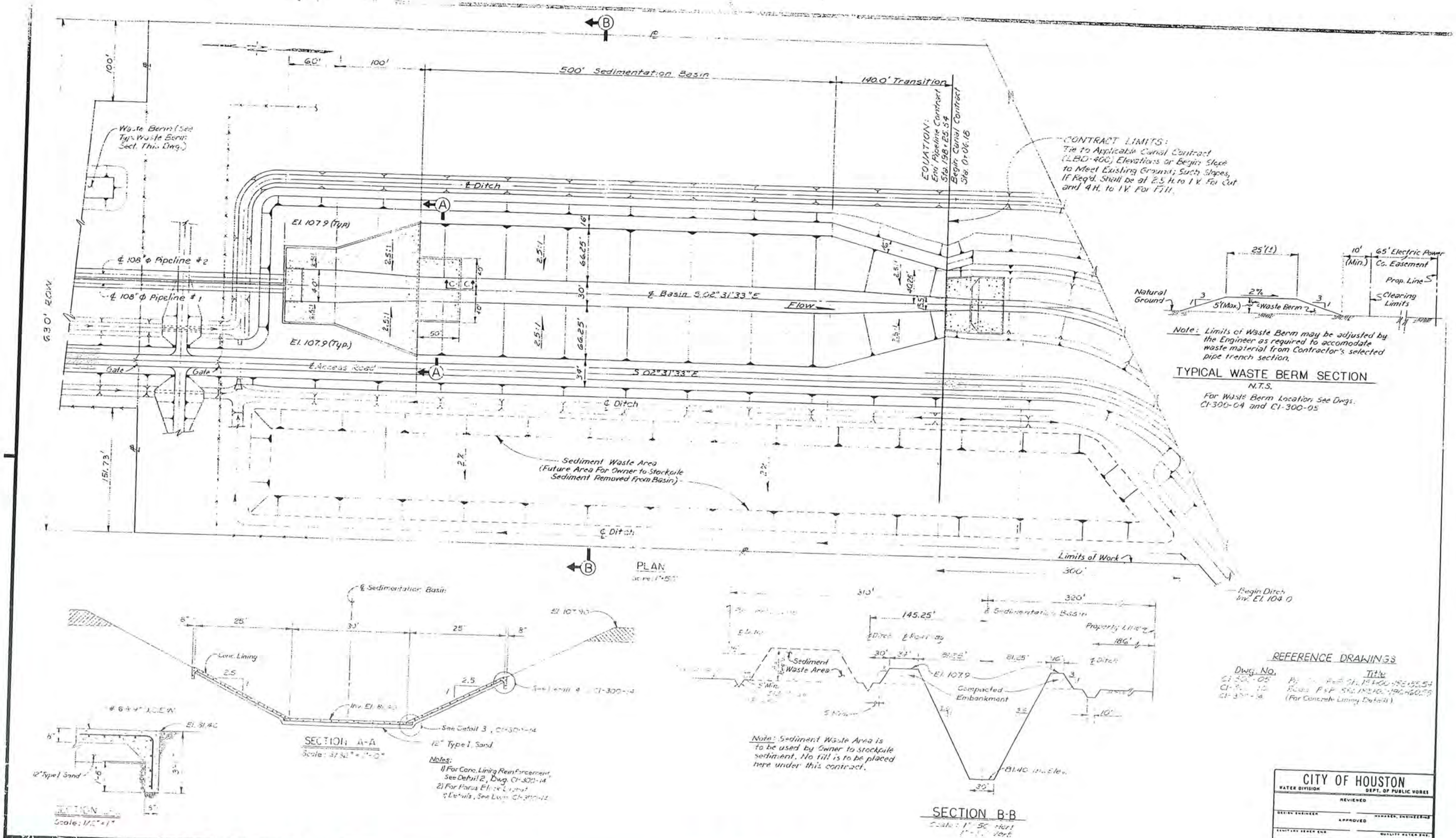
APPROVED

SEAL

CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS

TITLE OF DRAWING: PIPELINE PLAN & PROFILE 184+00 - 198+25.54
PIPEINE CONVEYANCE FACILITY
NAME OF OWNER: CITY OF HOUSTON
LOCATION OF PROJECT: LUCE BAYOU-LIBERTY CO, TEXAS

CONTRACT NO. LBD-300
DRAWING NO. CI-300-05
SHEET 8 OF 26



CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS

REVISION	BY	DATE	REVISION	BY	DATE

Brown & Root, Inc.
Engineers · Consultants
HOUSTON, TEXAS

TITLE OF DRAWING: SEDIMENTATION BASIN & WASTE AREA
PIPELINE CONVEYANCE FACILITY
NAME OF OWNER: CITY OF HOUSTON
LOCATION OF PROJECT: LUCE BAYOU LIBERTY CO, TEXAS

CONTRACT NO. LBD-300
DRAWING NO. CI-300-13
SHEET 16 OF 26

Appendix B

Section 4

CANAL CONVEYANCE FACILITY

CONTRACT NO. LBD-400

LUCE BAYOU DIVERSION PROJECT

WATER DIVISION PROJECT NO. 7392-4

CITY OF HOUSTON, TEXAS

MAYOR

Kathryn J. Whitmire

COUNCILMEN

Larry McKaskle	Dale Gorczynski
Ernest McGowen, Sr.	Ben T. Reyes
George Greanias	Jim Westmoreland
Rodney Ellis	Eleanor Tinsley
Frank Mancuso	Jim Greenwood
John G. Goodner	Anthony W. Hall, Jr.
Christin Hartung	Judson Robinson, Jr.

CONTROLLER

Lance Lalor

DEPT. OF PUBLIC WORKS

Jon C. Vanden Bosch — Director

BROWN & ROOT, INC.
ENGINEERS & CONSULTANTS

HOUSTON, TEXAS

DWG. NO. GG-400-01

CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS

REVIEWED

DESIGN ENGINEER	MANAGER, ENGINEERING
APPROVED	
SANITARY SEWER ENG.	QUALITY WATER ENG.
PAVING ENGINEER	STORM SEWER ENGINEER
BRIDGE ENGINEER	CONSTRUCTION ENG.
ASSISTANT DIRECTOR	DIRECTOR

NOTES

REVISIONS	BY	DATE

REVISIONS	BY	DATE

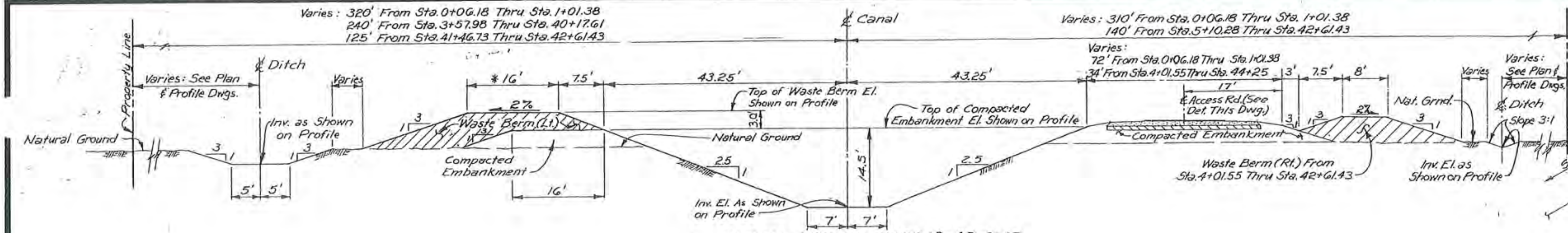
Brown & Root, Inc.
Engineers · Consultants
HOUSTON, TEXAS

DRAWN BY: MLL
DATE 9-75
CHK'D BY: B. Fucci
DATE 7/31/81
SCALE: As Shown

APPROVED
J. E. Jordan
APPROVED

TITLE OF DRAWING: PROJECT LOCATION MAP
CANAL CONVEYANCE FACILITY
NAME OF OWNER: CITY OF HOUSTON
LOCATION OF PROJECT: LUCE BAYOU, LIBERTY CO., TEXAS

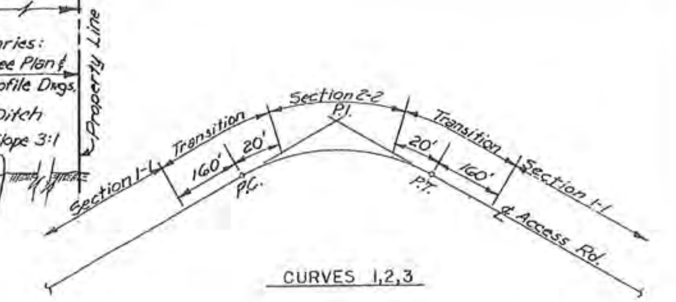
CONTRACT NO. LBD-400
DRAWING NO. G6-400-03
SHEET 3 OF 29



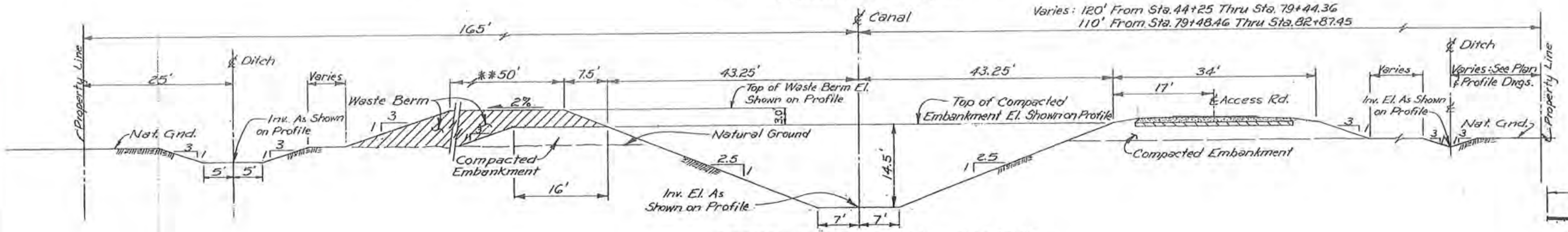
TYPICAL SECTION 0+06.18-42+61.43

SCALE: 1"=10'

* Note: Waste Berm (Lt.) Top Width Varies From 16' @ Sta.42+61.43 To 50' @ 44+25



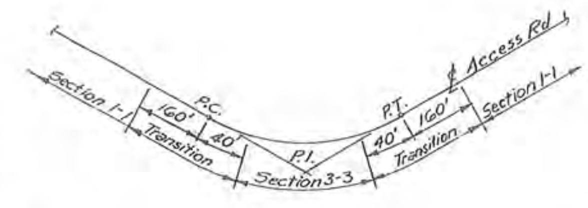
CURVES 1,2,3



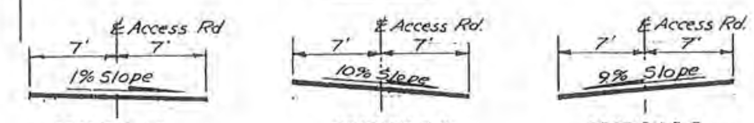
TYPICAL SECTION 44+25 - 82+87.45

SCALE 1"=10'

** Note: Waste Berm Top Width Varies From 50' At Sta.82+87.45 to 40' At Sta.83+93.18



CURVE 4



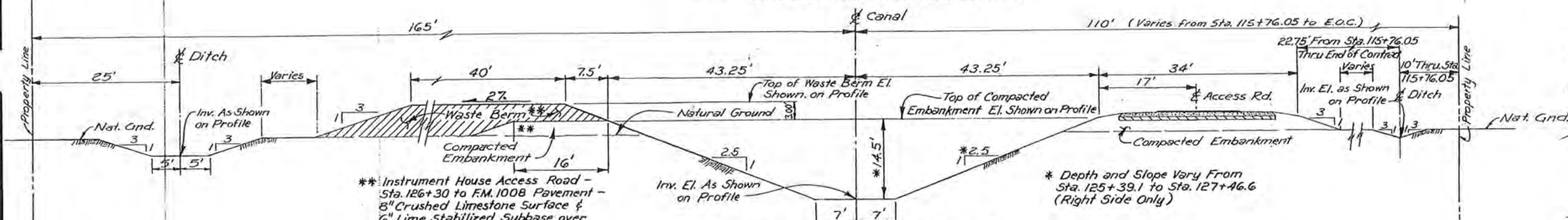
SECTION 1-1

SECTION 2-2

SECTION 3-3

SUPERELEVATION DETAILS

N.T.S.

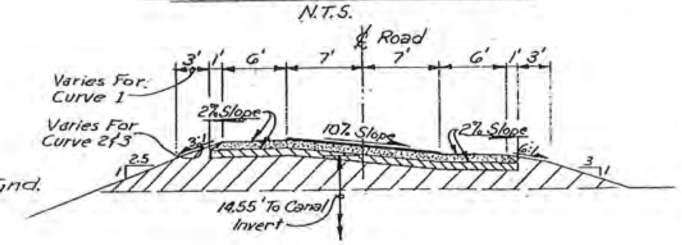


** Instrument House Access Road - Sta.126+30 to F.M.1008 Pavement - 8" Crushed Limestone Surface & 6" Lime Stabilized Subbase over Compacted Embankment (See Dwg. CI-400-11)

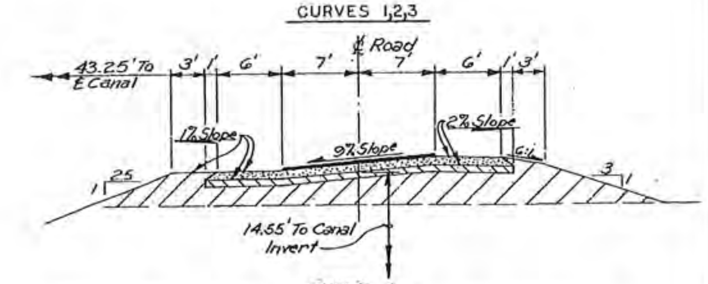
* Depth and Slope Vary From Sta.125+39.1 to Sta.127+46.6 (Right Side Only)

TYPICAL SECTION 83+93.18 - 127+46.6

SCALE: 1"=10'



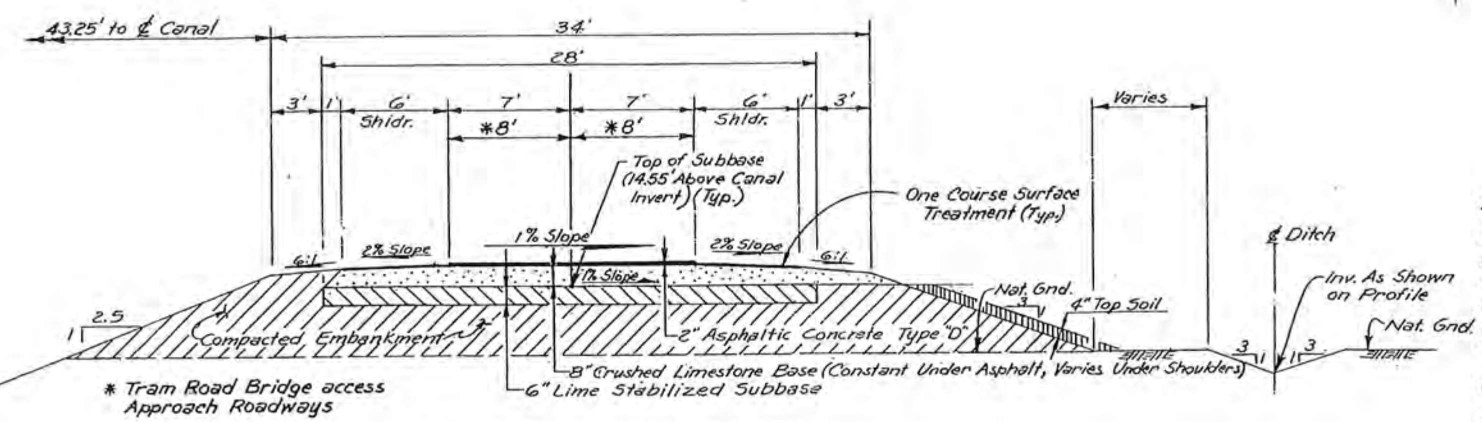
CURVES 1,2,3



CURVE 4

ACCESS ROAD SUPERELEVATION SECTIONS

Scale: ½"=1'-0"



* Tram Road Bridge access Approach Roadways

TYPICAL ACCESS ROAD SECTION

N.T.S.

REFERENCE DRAWINGS

Dwg. No.	Title
CI-400-01 thru CI-400-09	Plan & Profile Dwgs.
CI-400-11	Miscellaneous Details
CI-400-13	Fencing Layout & Details
CI-400-14	Tram Rd. Bridge-General Layout
CI-400-18	Drainage Structure Layouts Sht. 1 of 2
CI-400-19	Drainage Structure Layouts Sht. 2 of 2
CI-400-24	Drop Structures - Details Sht. 1 of 2
CI-400-25	Drop Structures - Details Sht. 2 of 2

CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS
REVIEWED / APPROVED
DESIGN ENGINEER — MANAGER, ENGINEERING
SANITARY SEWER ENG. — QUALITY WATER ENG.
PAVING ENGINEER — STORM SEWER ENGINEER
BRIDGE ENGINEER — CONSTRUCTION ENG.
ASSISTANT DIRECTOR — DIRECTOR

NOTES

REVISION	BY	DATE	REVISION	BY	DATE

Brown & Root, Inc.
Engineers · Consultants
HOUSTON, TEXAS

DRAWN BY: WEN
DATE 12-10-80
CHK'D BY: B. Lincei
DATE 7/31/81
SCALE: As Shown

APPROVED J. E. Jordan
APPROVED

STATE OF TEXAS — JACK E. JORDAN — 35024 — REGISTERED PROFESSIONAL ENGINEER — SEAL

TITLE OF DRAWING: TYPICAL CANAL & ACCESS RD. SECTIONS
CANAL CONVEYANCE FACILITY
NAME OF OWNER: CITY OF HOUSTON
LOCATION OF PROJECT: LUCE BAYOU-LIBERTY CO. TEXAS

CONTRACT NO. LBD-400
DRAWING NO. CI-400-10
SHEET 13 OF 29

Appendix B

Section 5

STREAM CONVEYANCE FACILITY

CONTRACT NO. LBD-500

LUCE BAYOU DIVERSION PROJECT

WATER DIVISION PROJECT NO. 7392-5

CITY OF HOUSTON, TEXAS

MAYOR

Kathryn J. Whitmire

COUNCILMEN

Larry McKaskle	Dale Gorczynski
Ernest McGowen, Sr.	Ben T. Reyes
George Greanias	Jim Westmoreland
Rodney Ellis	Eleanor Tinsley
Frank Mancuso	Jim Greenwood
John G. Goodner	Anthony W. Hall, Jr.
Christin Hartung	Judson Robinson, Jr.

CONTROLLER

Lance Lalor

DEPT. OF PUBLIC WORKS

Jon C. Vanden Bosch – Director

BROWN & ROOT, INC.
ENGINEERS & CONSULTANTS

HOUSTON, TEXAS

DWG. NO. GG-500-01

N

TARKINGTON BAYOU LEVEL TRANSMITTER

END PROPOSED CHANNEL STA. 613+60.68

PROPOSED CHANNEL

END PROPOSED CHANNEL STA. 613+60.68 EQUALS BEGIN CHANNEL CLEARING STA. 616+03.61

END CHANNEL CLEARING AND PROJECT, STA. 768+68.00

BEGIN PROJECT STA. 126+40.35

Canal Contract LBD-400 (By Others)

Existing Intake Structure

Exist Dam

Exist Reservoir

Tarkington Bayou

Long Branch

Luce Bayou

Tanner Bayou

Little Bayou

Mud Lake

Capers Ridge

Trinity River

MOBIL PIPE LINE

GULF PIPE LINE

F.M. 1008

HOUSTON PIPE LINE

GULF STATES UTILITIES TRANSMISSION LINE

STATE HWY. 321

Dayton 6 Miles

Dayton 8 Miles

Cleveland 12 Miles

(To FM 1960) FM 686

FM 686 (To SH 321)

100 75 50 25

2000 0 2000 4000 6000

SCALE IN FEET

CITY OF HOUSTON
WATER DIVISION — DEPT. OF PUBLIC WORKS

REVIEWED

DESIGN ENGINEER — MANAGER, ENGINEERING

APPROVED

SANITARY SEWER ENG. — QUALITY WATER ENG.

PAVING ENGINEER — STORM SEWER ENGINEER

BRIDGE ENGINEER — CONSTRUCTION ENG.

ASSISTANT DIRECTOR — DIRECTOR

NOTES

REVISIONS	BY	DATE	REVISIONS	BY	DATE

Brown & Root, Inc.
Engineers · Constructors
HOUSTON, TEXAS

DRAWN BY: HILL
DATE 07/75
CHK'D BY: J. Liucci
DATE 1-26-83
SCALE: AS SHOWN

APPROVED
J. E. Jordan
APPROVED

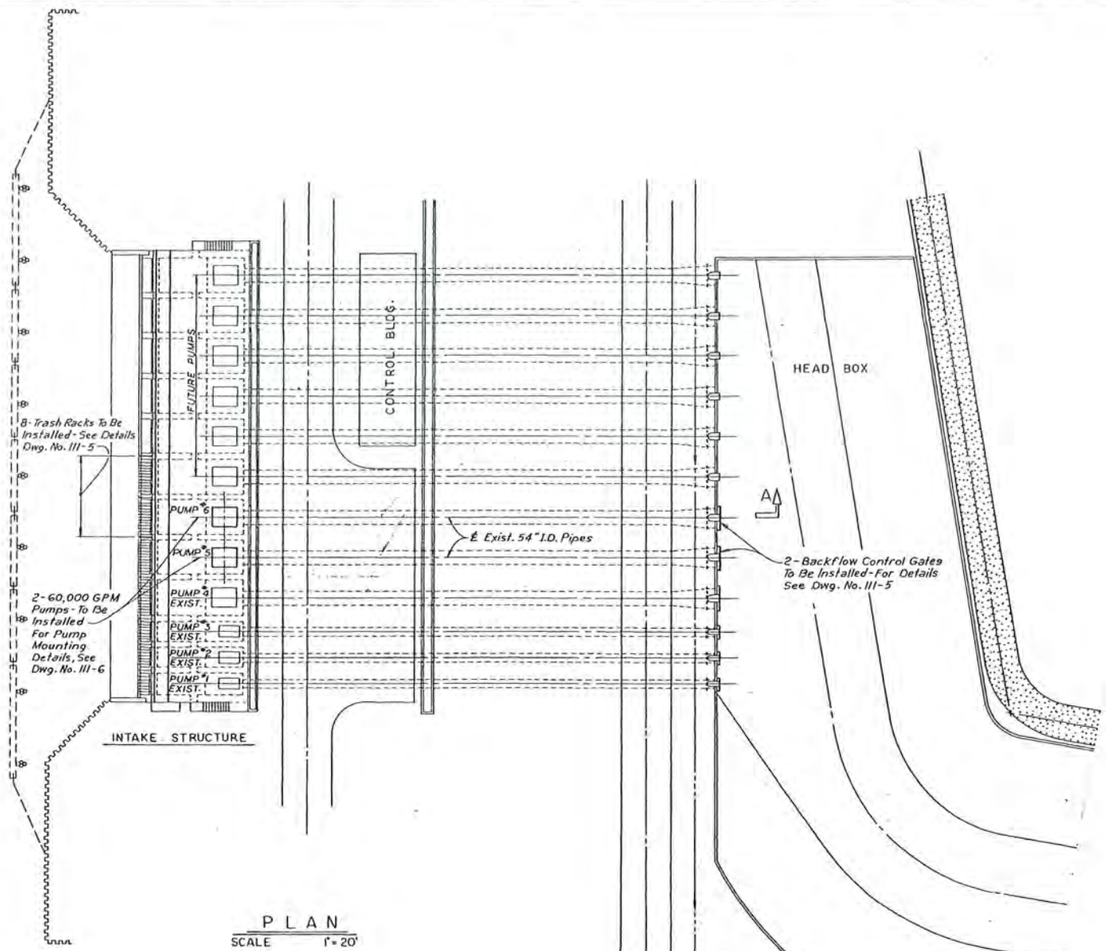
STATE OF TEXAS
WILLIAM LIUCCI
51355
REGISTERED PROFESSIONAL ENGINEER

TITLE OF DRAWING: PROJECT LOCATION MAP
STREAM CONVEYANCE FACILITY
NAME OF OWNER: CITY OF HOUSTON
LOCATION OF PROJECT: LUCE BAYOU, LIBERTY CO. TEXAS

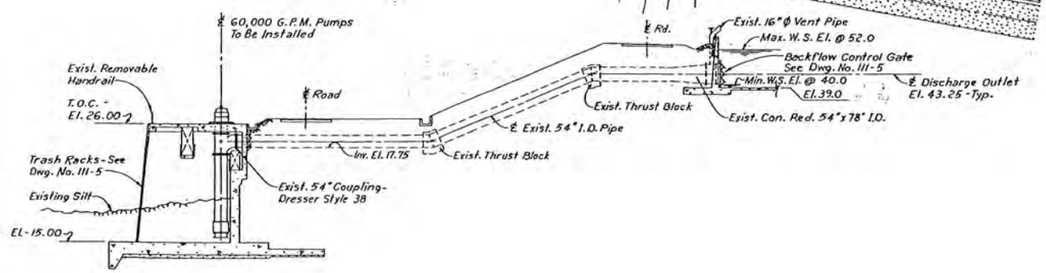
CONTRACT NO. LBD-500
DRAWING NO. GG-500-03
SHEET 3 OF 68

Appendix B

Section 6



PLAN
SCALE 1" = 20'



SECTION A-A
SCALE 1" = 20'

AS-BUILT

GENERAL NOTES

1 All materials shall be as noted in Specifications MC-III, which shall be the minimum acceptable standard.

2 All welding shall conform to applicable AWS Specifications if not otherwise specified.

3 For painting of "Trash Racks" see Specifications MC-III.

4 For grouting requirements see Specifications MC-III.

AS-BUILT
NOTICE: AS-BUILT INFORMATION SHOWN ON THIS DRAWING WAS DEVELOPED FROM INFORMATION PROVIDED BY CONTRACTOR, SUPPLIERS AND OTHERS. USER MUST VERIFY ACCURACY OF INFORMATION PRIOR TO USE. BROWN & ROOT, INC. AND/OR THE COASTAL WATER AUTHORITY MAKE NO WARRANTY AS TO THE ACCURACY OF THE INFORMATION SHOWN

CONTRACT MC - 111

COASTAL INDUSTRIAL WATER AUTHORITY OF TEXAS

TRINITY WATER CONVEYANCE SYSTEM FOR THE CITY OF HOUSTON, TEXAS

PHASE I

RIVER PUMP STATION-ADD'L. PUMPS 5 & 6 GENERAL PLAN

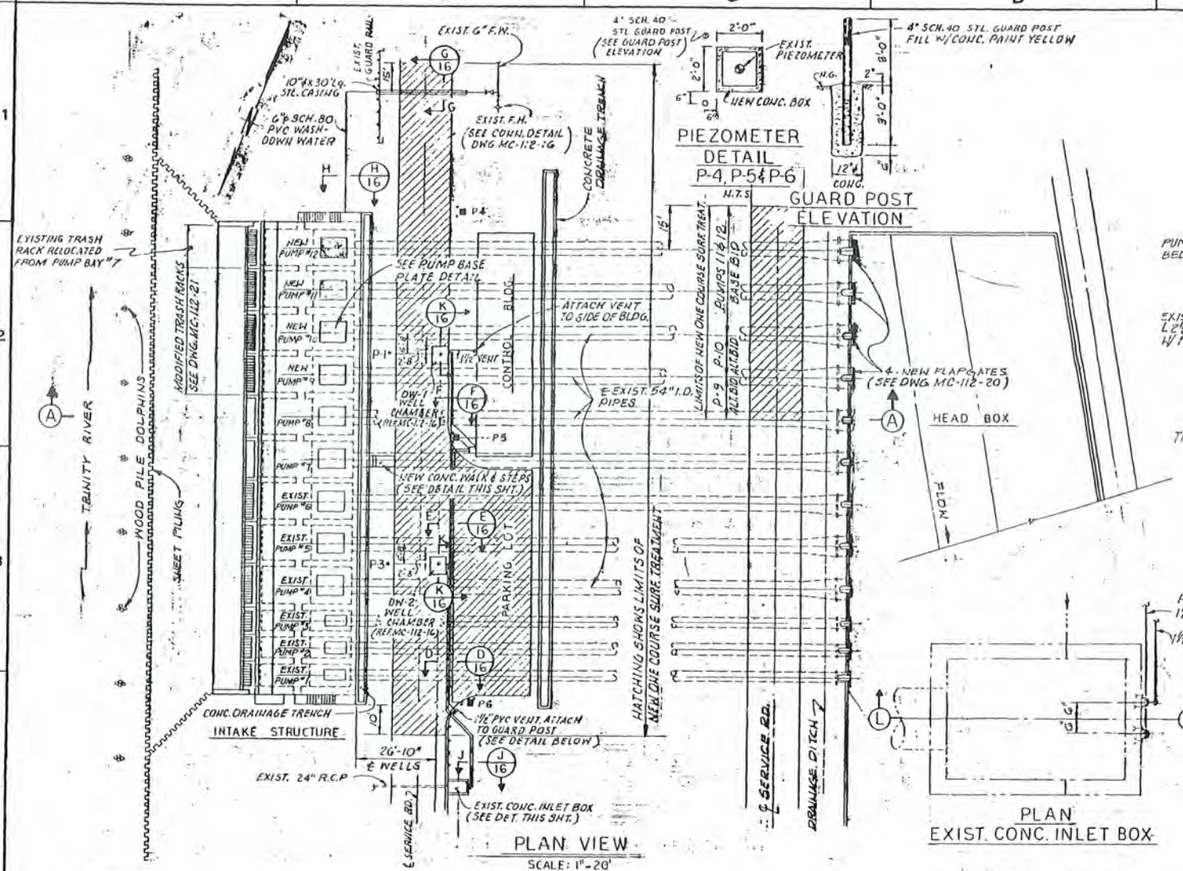
BROWN & ROOT, Inc.
Engineers - Consultants
HOUSTON, TEXAS

NO	DATE	REVISIONS	MADE	CKD
1	2-11-77	As Built - No Changes	K.T.	HFB

DESIGNED OLDEN	B&R APPROVAL	DATE
DRAWN ADAMES	CITY APPROVAL	DATE 4-25-74
CHECKED A. EWART	C.I.W.A. APPROVAL	DATE
JOB NO E-746	SCALE AS SHOWN	DWG. NO. III-4-1

STATE OF TEXAS W. W. EVANS 3867 REGISTERED PROFESSIONAL ENGINEER

MICROFILMED JUN 13 1977


EXIST. 6" F.M.
4" SCH. 40 STL. GUARD POST (SEE GUARD POST ELEVATION)
10"ϕ X 30'-0" STL. CASING
6"ϕ SCH. 80 PVC WASH-DOWN WATER
EXIST. GUARD RAIL
EXIST. F.H. (SEE COMM. DETAIL DWG. MC-112-16)
CONCRETE DRAINAGE TRENCH
EXISTING TRASH RACK RELOCATED FROM PUMP BAY #7
MODIFIED TRASH RACKS (SEE DWG. MC-112-21)
TRINITY RIVER
WOOD PILE DOLPHIN
SHEET PILING
NEW PUMP #12
NEW PUMP #11
NEW PUMP #10
NEW PUMP #9
PUMP #8
EXIST. PUMP #6
EXIST. PUMP #5
EXIST. PUMP #4
EXIST. PUMP #3
EXIST. PUMP #2
EXIST. PUMP #1
SEE PUMP BASE PLATE DETAIL
ATTACH VENT TO SIDE OF BLDG.
CONTROL BLDG.
1½" VENT
P-1
P-2
P-3
P-4
P-5
DW-1 WELL CHAMBER (REF. MC-112-16)
DW-2 WELL CHAMBER (REF. MC-112-16)
NEW CONC. WALK & STEPS (SEE DETAIL THIS SHT.)
PARKING LOT
E EXIST. 54" I.D. PIPES
4 - NEW FLAPGATES (SEE DWG. MC-112-20)
HEAD BOX
NOTE
HATCHING SHOWS LIMITS OF NEW ONE COURSE SURF. TREATMENT
CONC. DRAINAGE TRENCH
INTAKE STRUCTURE
26'-10"
℄ WELLS
EXIST. 24" R.C.P.
EXIST. CONC. INLET BOX (SEE DET. THIS SHT.)
℄ SERVICE RD.
DRAINAGE DITCH
¾"ϕ PVC VENT. ATTACH TO GUARD POST (SEE DETAIL BELOW)
PLAN VIEW
SCALE: 1"=20'
PIEZOMETER DETAIL P-4, P-5 & P-6
2'-0"
EXIST. PIEZOMETER
H.G.
6" CONC. BOX
8'-0"
2'-0"
3'-0"
12" CONC.
GUARD POST ELEVATION
N.T.S.
P-4
P-5
P-6
12"
8" SCH. 40 STL. GUARD POST FILL W/ CONC. PAINT YELLOW
PLAN
EXIST. CONC. INLET BOX
PUMP DISCH. 1½"ϕ PVC FROM WELL NO. 2
1½"ϕ PVC FROM WELL NO. 1
EXIST. 3"ϕ SLEEVE
1¼" ANCHOR BOLT - THREADED 2 ENDS, 7-NC x 3'-1" LG. W/ HEAVY DUTY HEX NUTS. ALL STAINLESS STEEL 304
THREAD LENGTH 3"
¼" WASHER
EL. 26.00
PUMP MOUNTING BED PLATE
EXISTING L 2½ x 2 x ¼ W/ FLAT BAR
1" GROUT
PUMP & DISCHARGE
THREAD LENGTH 2"
½" PL
TACK WELD
4½" SQUARE
SECTION B-B
SCALE 1½" = 1'-0"
EXIST. OPENING WITH CHECKERED PL COVER (SEE NOTE 2)
10'-4"
9'-0"
EXISTING 6" CONDUIT
DRILL 4 - 1½" ϕ HOLES FOR ANCHOR BOLTS (TYP.)
EXISTING EMBEDDED ANGLE
3'-4"
DISCHARGE
EXISTING 3" CONDUIT
7'-4"
LOCATION AND SIZE OF HOLES TO BE DETERMINED BY PUMP MANUFACTURER
BASE PLATE
EXISTING 3¼ x 2'-6" LG. 28 GA. SHEET METAL SLEEVE (TYP. FOR 4) TOP OF SLEEVE EL. 26.0
NOTE
1. VERIFY EXISTING DIMENSIONS IN THE FIELD.
2. REMOVE EXISTING CHECKERED PLATE COVERS AND DELIVER TO CWA STATION OPERATOR.
PUMP BASE PLATE DETAIL
SCALE: ½"=1'-0"
℄ NEW PUMP
T.O.C. EL. 26.0'
4 - STANDARD "CRON-FEET" CAST STEEL LUGS TO SUIT EXIST. DRESSER (TYP.)
TYP.
54" COUPLING DRESSER TYPE 38 EXIST. (PROVIDE NEW GASKET)
4 - ⅞" ϕ ANCHOR BOLTS (TYP.) - EXIST.
B.C.
6'-8"
PUMP ELBOW 54" I.D. x ½" WALL
℄ EXIST. 54" I.D. x ⅜" WALL PIPE
INV. EL. 17.75
REMOVE EXISTING PIPE CAP & DELIVER TO LOCATION ON SITE DESIGNATED BY ENGINEER
1'-0"
2'-0⅛"
TO BE DETERMINED BY PUMP MANUFACTURER
EXISTING 2" GATE VALVE AND PIPE TO BE REMOVED
½" GAP
NOTES:
1. VERIFY EXISTING DIMENSIONS IN THE FIELD.
DRESSER COUPLING DETAIL
SCALE ½" = 1'-0"
℄ EXIST. CONC. DRAIN
GUARD RAIL POST
CONC. SIDEWALK
5'-9"
4'-0"
EDGE OF EXIST. RD. PAV'T.
PLAN
11" 11"
1"x1" ASPHALTIC SEALER
EMBED. NOSLIP ALUM. NOSE ANGLE (TYP.)
5 - 3.3%±
#4 bar TYP.
#4@12" E.W.
4" CEMENT STABILIZED SAND BEDDING
½" EXP. JT. MAT'L.
8'-6"±
CONC. WALK AND STEPS
SECTION C-C
SCALE 3/8" = 1'-0"
NOTE: CONC. STEPS SHALL BE UNDER ITEM 12.
DETAIL NEW CONC. WALK AND STEPS
SCALE 3/8" = 1'-0"
WELL CHAMBER VENT. TERMINAL
N.T.S.
1½" PVC VENT
1½" PIPE STRAP (H.D.G.) ATTACH TO MASONRY W/ ⅜"ϕ GAL. EXP. ANCHORS OR TO WOOD POST W/ ⅜"ϕ x 2½" LAG BOLTS.
(EXIST. CONTROL BLDG.)
SST INSECT SCREEN W/ SST CLAMP
1'-0"
PUMP DISCH. 1½"ϕ PVC FROM WELL NO. 1
EL. 28.07
ATTACH PIPE TO EXIST. CONC. INLET BOX W/ 1½" PIPE STRAP & ⅜" EXPANSION ANCHOR. H.D.G. (TYP.)
SECTION L-L
℄ DEWATERING WELL
℄ NEW PUMP
26'-10"
CONTROL BUILDING
HANDRAIL
℄ ROAD
T.O.C. EL. 26.0
MAX. W.S. EL. 22.0
FLOW
℄ PUMP DISCHARGE EL. 20.0
NORMAL W.S. EL. 2.0
LOW W.S. EL. 0.0
TRASH RACK (TYP.)
T.O.C. EL. (-) 15.0
EL. (-) 10.0?
INV. EL. 17.75
SEE DRESSOR COUPLING DETAIL
EXISTING 54" COUPLING DRESSOR TYPE 38
℄ EXIST. 54" I.D. PIPE
EXIST. THRUST BLOCK
℄ ROAD
EXIST. 16"ϕ VENT PIPE
MAX. W.S. EL. 52.0
NORMAL W.S. EL. 49.4
FLAPGATE
MIN. W.S. EL. 41.0
EL. 39.0
EXIST. THRUST BLOCK
EXIST. CON. RED. 54" x 78" I.D.
℄ DISCHARGE OUTLET EL. 43.25 (TYP.)
SECTION A-A
SCALE: 1"=20'
NOTES:
1. PIEZOMETERS 1, 3, 4, 5 & 6 ARE EXISTING.
2. DW-1 & DW-2 ARE NEW DEWATERING WELLS.
NOTES:
1. ALL ELEVATIONS ARE BROWN & ROOT PROJECT DATUM. (SEE DWG. MC-112-03 FOR BENCH MARKS.)
AS-BUILT
NOTICE: AS-BUILT INFORMATION SHOWN ON THIS DRAWING WAS DEVELOPED FROM INFORMATION PROVIDED BY CONTRACTOR, SUPPLIERS AND OTHERS. USER MUST VERIFY ACCURACY OF INFORMATION PRIOR TO USE. BROWN & ROOT, INC. AND/OR THE COASTAL WATER AUTHORITY MAKE NO WARRANTY AS TO THE ACCURACY OF THE INFORMATION SHOWN
STATE OF TEXAS
MICHAEL I. SPERO
49754
REGISTERED PROFESSIONAL ENGINEER
1 6-18-91 AS-BUILT J.H. MB
NO DATE REVISIONS MADE CKD
COASTAL WATER AUTHORITY OF TEXAS
TRINITY WATER CONVEYANCE SYSTEM FOR THE CITY OF HOUSTON, TEXAS
CONTRACT NO. MC-112
RIVER PUMP STATION
PLAN VIEW, SECTION & DETAILS
BROWN & ROOT, Inc.
Engineers · Consultants
HOUSTON, TEXAS
DESIGNED M.I. SPERO
DRAWN D. HARRIS
CHECKED J. OLDEN
BAR APPROVAL
CITY APPROVAL
C.W.A. APPROVAL
DATE 6/24/91
JOB NO JR-0756
SCALE AS SHOWN
DWG. NO. MC-112-10-1

DWG. NO.	TITLE
100-1-1	INDEX OF CONTRACT DRAWINGS
100-2-1	GENERAL VICINITY MAP - SECTIONS 1 & 2 - CONTRACT NO. MC-100
100-3-1	PROJECT LOCATION MAP - " " " " " " " "
200-1-6	RIVER PUMP STATION - CLEARING & GRADING PLAN
200-2-3	" " " - PLOT PLAN
201-1-1	RIVER PUMP STATION - INTAKE STRUCTURE - EXCAVATION & BACKFILL
201-2-1	" " " - ACCESS ROAD - PLAN & PROFILE
201-3-1	" " " - STATION ROAD - PLAN & PROFILE
201-4-2	" " " - " " - TYPICAL SECTIONS
201-5-1	" " " - DRAINAGE DETAILS
201-6-1	" " " - " "
202-1-1	RIVER PUMP STATION - INTAKE STRUCTURE - PLAN AT ELEVATION +26.0' & SECTIONS
202-2-1	RIVER PUMP STATION - INTAKE STRUCTURE - PLAN AT ELEVATION +16.5' & ELEVATION +10.0'
202-3-2	RIVER PUMP STATION - INTAKE STRUCTURE - MAT PLAN & SECTIONS
202-4-1	" " " - " " - WALL SECTIONS
202-5-1	" " " - " " - END WALLS
202-6-1	" " " - " " - TYPICAL WALL SECTIONS
202-7-1	" " " - " " - SECTIONS & DETAILS
202-8-1	" " " - " " - " " "
202-9-1	" " " - CONTROL BLDG. - FLOOR SLAB - PLAN
202-10-1	" " " - SHOP BLDG. - FOUNDATION & FLOOR SLAB - PLAN
203-1-2	RIVER PUMP STATION - INTAKE STRUCTURE - TRASH RACKS & GUIDES
203-2-1	" " " - " " - MISC. STEEL DETAILS
203-3-1	" " " - " " - SHEET PILE WALLS & DOLPHINS
204-1-1	RIVER PUMP STATION - CONTROL BLDG. - FLOOR PLAN, SECTIONS & DETAILS
204-2-1	" " " - " " - WALL SECTIONS & DETAILS
204-3-1	" " " - " " - ELEVATIONS, PLANS & DETAILS
204-4-1	" " " - SHOP BLDG. - FLOOR PLAN, ELEVATIONS & SECTIONS
204-5-2	" " " - UTILITY BLDG. - FLOOR PLAN & ELEVATIONS
205-1-AB	RIVER PUMP STATION - ELECTRICAL ONE LINE DIAGRAM
205-2-AB	" " " - CONDUIT & CABLE SCHEDULE
205-3-AB	" " " - CONTROL BUILDING - CONDUIT LAYOUT
205-4-AB	" " " - GROUNDING LAYOUT
205-5-1	" " " - INTAKE STRUCTURE - LIGHTING PLAN & DETAILS
205-6-AB	" " " - " " - GENERAL LIGHTING LAYOUT
205-7-AB	" " " - CONTROL BLDG. & SHOP BLDG. LIGHTING
205-8-AB	" " " - INTAKE STRUCTURE - CABLE TRAY ROUTING PLAN
205-9-AB	" " " - MOTOR SCHEMATICS
205-10-AB	" " " - LOW VOLTAGE DISTRIBUTION
206-1-2	RIVER PUMP STATION - INSTRUMENTATION DETAILS
206-2-2	RIVER PUMP STATION - CONTROL BLDG. - OPERATORS CONTROL PANEL
207-1-2	RIVER PUMP STATION - INTAKE STRUCTURE - DISCHARGE PIPING & TRASH RAKE - PLAN
207-2-1	RIVER PUMP STATION - INTAKE STRUCTURE - DISCHARGE PIPE & TRASH RAKE - SECTIONS
207-3-1	RIVER PUMP STATION - INTAKE STRUCTURE - DISCHARGE PIPE & TRASH RAKE - DETAILS
207-4-1	RIVER PUMP STATION - RIVER LEVEL - STILLING WELL
207-5-2	" " " - PLUMBING PLOT PLAN
207-6-2	" " " - SEWAGE TREATMENT UNIT & FUEL STORAGE TANKS
207-7-2	" " " - CONTROL BLDG. - PLUMBING PLAN & FIRE PUMP DETAILS
207-8-1	" " " - SHOP BLDG. - PLUMBING PLAN & DETAILS
207-9-2	" " " - PLUMBING FOUNDATION DETAILS
207-10-1	" " " - CONTROL BLDG. - AIR CONDITIONING PLAN & DETAILS
300-1-5	MAIN CANAL - PLAN & PROFILE - STA. 0+00 TO 60+00
300-2-2	" " " " " - STA. 60+00 TO 120+00
300-3-1	" " " " " - STA. 360+00 TO 420+00
300-4-1	MAIN CANAL - PLAN & PROFILE - STA. 420+00 TO 434+00
300-5-2	MAIN CANAL - TYPICAL SECTIONS
300-6-3	" " " "
300-7-1	" " - FENCING DETAILS
301-1-1	MAIN CANAL - HEAD BOX PLAN
301-2-1	" " - " " WALL SECTIONS
301-3-1	" " - " " TRANSITION SECTIONS
301-4-1	" " - " " DETAILS
301-5-1	" " - " "
302-1-1	MAIN CANAL - PARSHALL FLUME - GENERAL LAYOUT
302-2-1	" " - " " - PLAN & PROFILE
302-3-1	" " - " " - INLET TRANSITION - PLAN
302-4-1	" " - " " - " " - SECTIONS
302-5-1	" " - " " - FLUME - PLAN
302-6-1	" " - " " - " " - SECTIONS
302-7-1	" " - " " - STILLING WELL & GAGE BOX
302-8-1	" " - " " - OUTLET TRANSITION - PLAN
302-9-1	" " - " " - " " - SECTIONS
304-1-2	MAIN CANAL - F.M. 1409 BRIDGE CROSSING - GENERAL LAYOUT
304-2-2	" " - " " " " - DETOUR PLAN & PROFILE
304-3-2	" " - " " " " - TYPICAL SECTIONS
304-4-2	" " - " " " " - BRIDGE LAYOUT
304-5-2	" " - " " " " - PILE & BENT DETAILS
304-6-2	" " - " " " " - SLAB & GIRDER DETAILS
304-7-2	" " - " " " " - MISCELLANEOUS DETAILS
306-1-1	MAIN CANAL - S. H. 146 BRIDGE CROSSING - GENERAL LAYOUT
306-2-1	" " - " " " " - DETOUR PLAN & PROFILE
306-3-1	" " - " " " " - TYPICAL SECTIONS
306-4-1	" " - " " " " - BRIDGE LAYOUT
306-5-1	" " - " " " " - PILE & BENT DETAILS
306-6-1	" " - " " " " - SLAB & GIRDER DETAILS
306-7-1	" " - " " " " - MISCELLANEOUS DETAILS
307-1-1	MAIN CANAL - CEDAR POINT TURNOUT - LAYOUT & PLOT PLAN
307-2-1	" " - " " " - PLAN & PROFILE
307-3-1	" " - " " " - ROADWAY LAYOUT
307-4-1	" " - " " " - UPSTREAM TRANSITION - PLAN
307-5-1	" " - " " " - " " - SECTIONS
307-6-1	" " - " " " - MAIN RECTANGULAR CHANNEL - PLAN
307-7-1	MAIN CANAL - CEDAR POINT TURNOUT - MAIN RECTANGULAR CHANNEL - SECTIONS
307-8-1	MAIN CANAL - CEDAR POINT TURNOUT - DOWNSTREAM TRANSITION - PLAN
307-9-1	MAIN CANAL - CEDAR POINT TURNOUT - DOWNSTREAM TRANSITION - SECTIONS
307-10-1	MAIN CANAL - CEDAR POINT TURNOUT - LATERAL CHANNEL - PLAN
307-11-1	" " - " " " " - " " - SECTIONS
307-12-1	" " - " " " " - SLIDE GATE WALL
307-13-2	" " - " " " " - VEHICULAR BRIDGES
307-14-1	" " - " " " " - RADIAL GATE HOIST
307-15-1	" " - " " " " - " " " " DETAILS
307-16-1	" " - " " " " - " " " " "
307-17-1	" " - " " " " - " " " DETAILS
307-18-1	" " - " " " " - " " " "
307-19-1	" " - " " " " - " " " "
307-20-1	" " - " " " " - STOP LOG DETAILS
307-21-1	" " - " " " " - " " " "
307-22-1	" " - " " " " - MISCELLANEOUS DETAILS
307-23-2	" " - " " " " - " " " "
400-1-3	CANAL MAINTENANCE STATION - GRADING PLAN
400-2-1	" " " - PLOT PLAN
401-1-2	CANAL MAINTENANCE STATION - ACCESS ROAD PLAN & PROFILE
402-1-1	CANAL MAINTENANCE STATION - OPERATIONS BLDG. - FOOTINGS & FLOOR SLAB
402-2-1	CANAL MAINTENANCE STATION - OPERATIONS BLDG. - PIT DETAILS
403-1-1	CANAL MAINTENANCE STATION - OPERATIONS BLDG. - ROOF FRAMING
404-1-1	CANAL MAINTENANCE STATION - OPERATIONS BLDG. - FLOOR PLAN
404-2-1	" " " - " " - ELEVATIONS
404-3-1	" " " - " " - WALL SECTIONS
404-4-1	" " " - " " - DETAILS
404-5-1	" " " - " " - DETAILS
404-6-1	" " " - EQUIPMENT SHEDS
405-1-AB	CANAL MAINTENANCE STATION - ONE LINE & SCHEMATIC DIAGRAMS
405-2-AB	" " " - GROUNDING LAYOUT
405-3-AB	" " " - AREA POWER & LIGHTING
405-4-AB	" " " - OPERATIONS BLDG. - LIGHTING LAYOUT
405-5-AB	CANAL MAINTENANCE STATION - POWER CONDUIT LAYOUT
406-1-1	CANAL MAINTENANCE STATION - INSTRUMENTATION DETAILS
406-2-1	" " " - OPERATIONS BLDG. - OPERATORS CONSOLE
407-1-1	CANAL MAINTENANCE STATION - PLUMBING PLOT PLAN
407-2-2	" " " - OPERATIONS BLDG. - PLUMBING PLAN
407-3-1	" " " - " " - AIR CONDITIONING PLAN

AS-BUILT

CONTRACT MC-100

APPROVED:
COASTAL INDUSTRIAL WATER AUTHORITY
By: Louis Lenz Director
Date: JUL 15 1969

NO	DATE	REVISIONS	MADE	CKD
△	3-23-71	"As Built (Added Revision Numbers)"	TBH	

W. W. EVANS 3357 REGISTERED ENGINEER STATE OF TEXAS

COASTAL INDUSTRIAL WATER AUTHORITY OF TEXAS

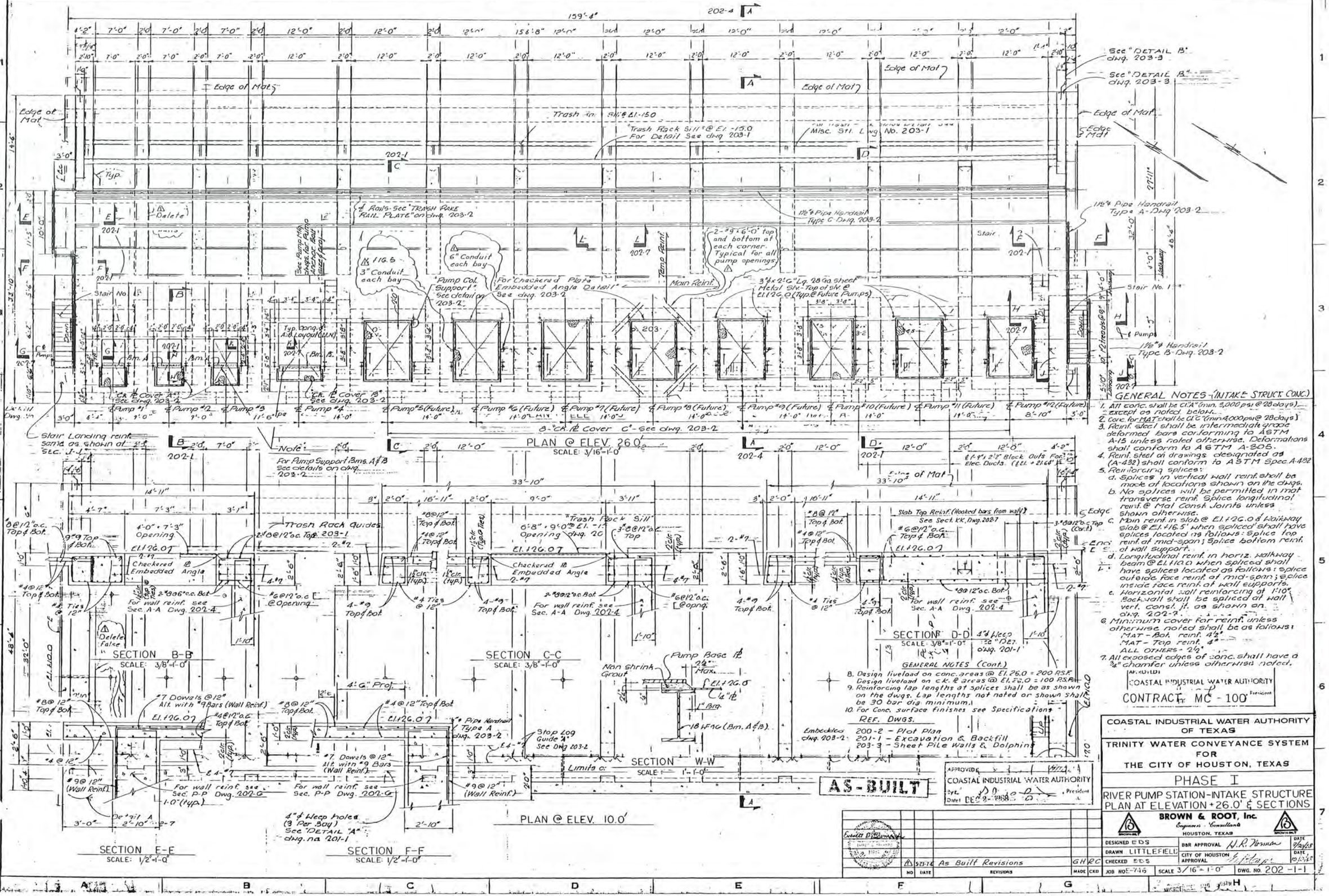
TRINITY WATER CONVEYANCE SYSTEM FOR THE CITY OF HOUSTON, TEXAS

PHASE I

INDEX OF CONTRACT DRAWINGS

BROWN & ROOT, Inc.
Engineers Consultants
HOUSTON, TEXAS

DESIGNED		
DRAWN	MANNING	
CHECKED	LITTMANN	
B&R APPROVAL		DATE
CITY OF HOUSTON APPROVAL		DATE 10-20-69
JOB NO E-746	SCALE	DWG NO. 100-1-1



GENERAL NOTES (INTAKE STRUCT CONC.)

1. All conc. shall be Cl "A" (min. 3,000 psi @ 28 days) except as noted below.
2. Conc. for MAT shall be Cl "C" (min 4,000 psi @ 28 days)
3. Reinf. steel shall be intermediate grade deformed bars conforming to ASTM A-15 unless noted otherwise. Deformations shall conform to ASTM A-305.
4. Reinf. steel on drawings designated as (A-432) shall conform to ASTM Spec. A-432
5. Reinforcing splices:
   a. Splices in vertical wall reinf. shall be made of locations shown on the dwgs.
   b. No splices will be permitted in mat transverse reinf. Splice longitudinal reinf. @ Mat Const. Joints unless shown otherwise.
   c. Main reinf. in slab @ El. +26.0' Walkway slab @ El. +16.5' when spliced shall have splices located as follows: Splice top reinf. at mid-span; Splice bottom reinf. at wall support.
   d. Longitudinal reinf. in horiz. walkway beam @ El. 11.0 when spliced shall have splices located as follows: splice outside face reinf. at mid-span; splice inside face reinf. at wall supports.
   e. Horizontal wall reinforcing at 1'-10" Back wall shall be spliced at wall vert. const. jt. as shown on dwg. 202-2.
6. Minimum cover for reinf. unless otherwise noted shall be as follows:
   MAT - Bot. reinf. 4"
   MAT - Top reinf. 4"
   ALL OTHERS - 2"
7. All exposed edges of conc. shall have a ¾" chamfer unless otherwise noted.

GENERAL NOTES (Cont.)

8. Design liveload on conc. areas @ El. 26.0 = 200 P.S.F. Design liveload on C.K. & areas @ El. 26.0 = 100 P.S.F.
9. Reinforcing lap lengths at splices shall be as shown on the dwgs. Lap lengths not noted or shown shall be 30 bar dia. minimum.
10. For Conc. surface finishes see Specifications

REF. DWGS.

Embedded dwg. 203-2: 200-2 - Plot Plan; 201-1 - Excavation & Backfill; 203-3 - Sheet Pile Walls & Dolphins

APPROVED: COASTAL INDUSTRIAL WATER AUTHORITY
By: _____ President
Date: DEC 2 1968

COASTAL INDUSTRIAL WATER AUTHORITY OF TEXAS

TRINITY WATER CONVEYANCE SYSTEM FOR THE CITY OF HOUSTON, TEXAS

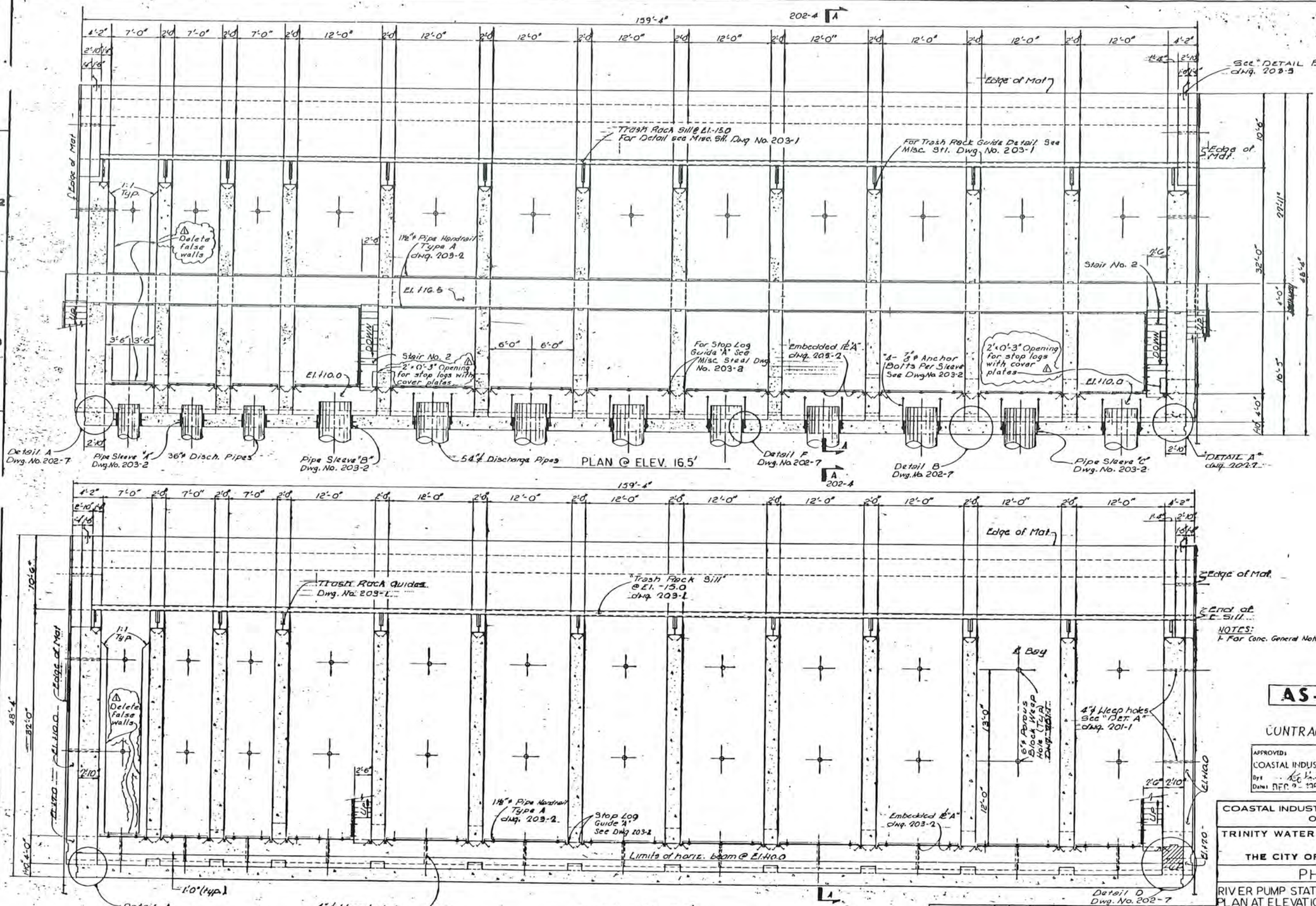
PHASE I

RIVER PUMP STATION-INTAKE STRUCTURE PLAN AT ELEVATION +26.0' & SECTIONS

BROWN & ROOT, Inc. Engineers - Consultants HOUSTON, TEXAS

DESIGNED EDS	B&R APPROVAL N.R. Norman	DATE	9/24/68
DRAWN LITTLEFIELD	CITY OF HOUSTON APPROVAL	DATE	10/3/68
CHECKED EDS			
JOB NO. E-746	SCALE 3/16"=1'-0"	DWG. NO.	202-1-1

NO	DATE	REVISIONS	MADE	CKD
A	5-71-6	As Built Revisions	GH	RC



AS-BUILT

CONTRACT MC - 100

APPROVED:
COASTAL INDUSTRIAL WATER AUTHORITY
By: [illegible] , President
Date: DEC 9 - 1969

THIS DRAWING FOR INFORMATION PURPOSES ONLY

ALL DIMENSIONS AND DETAILS REQUIRED FOR THE WORK UNDER THIS CONTRACT SHALL BE FIELD VERIFIED

NO	DATE	REVISIONS	MADE	CKD
1	10-70	As Built Revisions	GH	RC

COASTAL INDUSTRIAL WATER AUTHORITY OF TEXAS

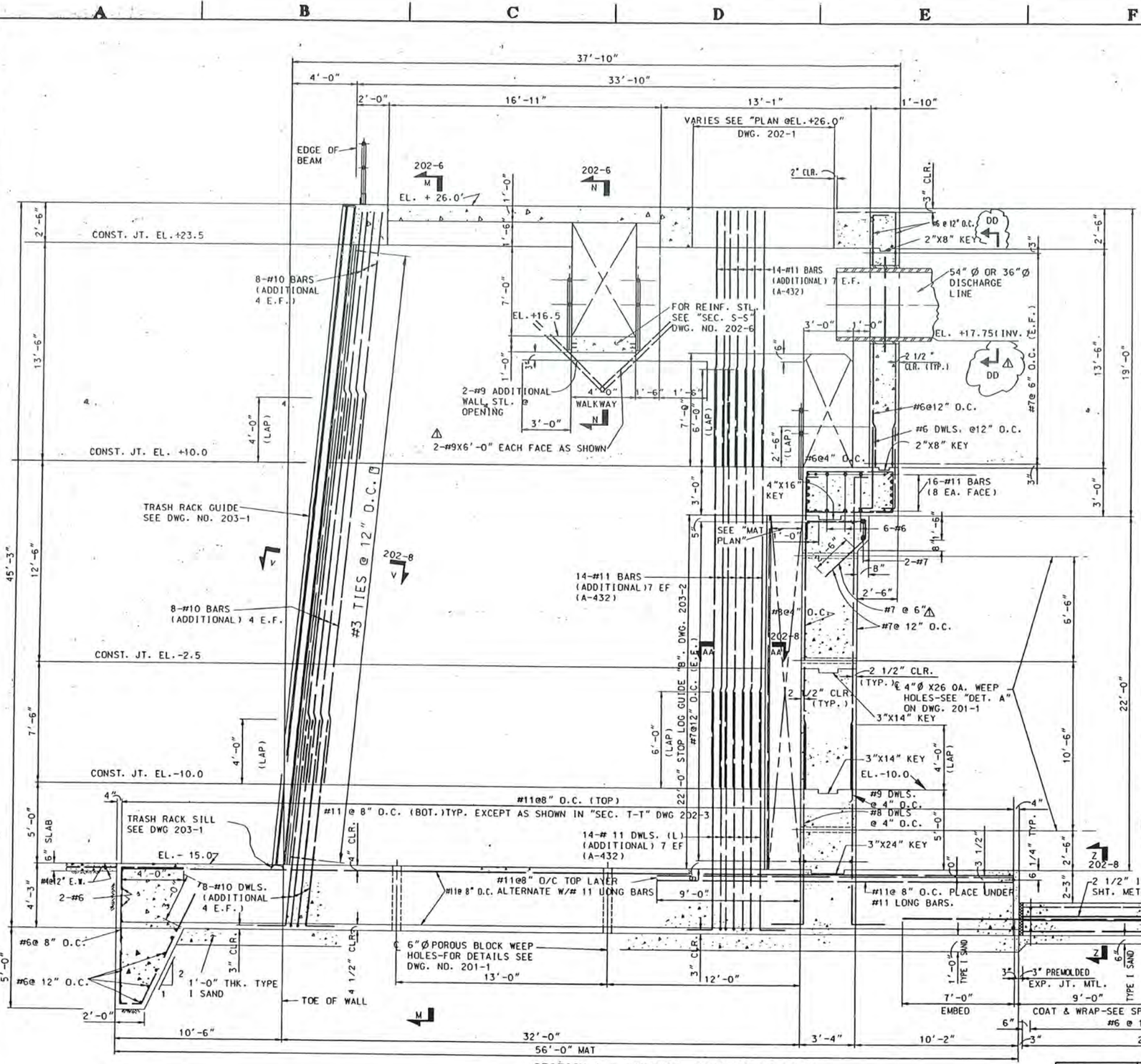
TRINITY WATER CONVEYANCE SYSTEM FOR THE CITY OF HOUSTON, TEXAS

PHASE I

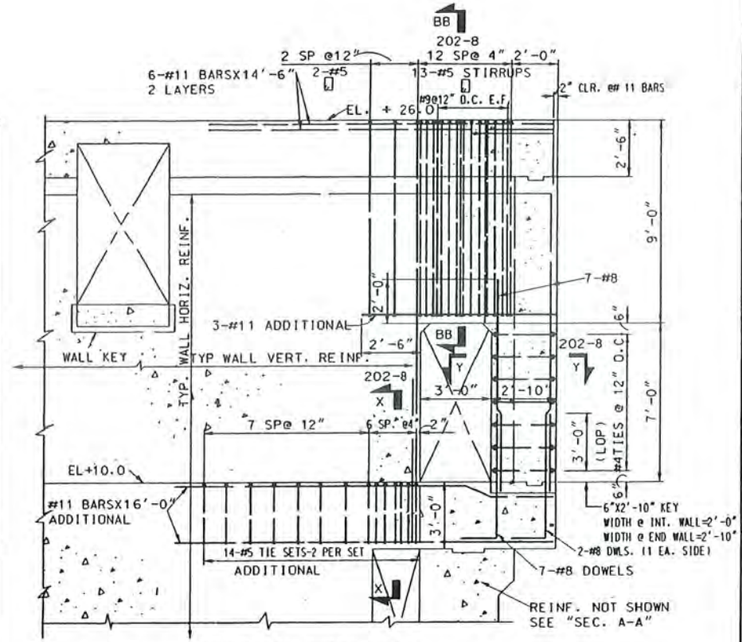
RIVER PUMP STATION-INTAKE STRUCTURE PLAN AT ELEVATION +16.5' & ELEVATION +10.0

BROWN & ROOT, Inc. Engineers - Consultants HOUSTON, TEXAS

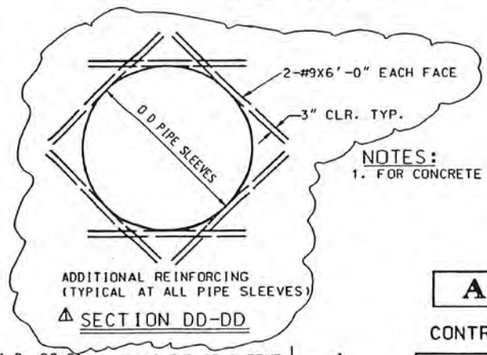
DESIGNED EDS	B&R APPROVAL H.R. Thomas	DATE 1/21/68
DRAWN LITTLEFIELD	CITY OF HOUSTON APPROVAL [illegible]	DATE 10/1/68
CHECKED EDS	JOB NO E-746 SCALE 3/16"=1'-0"	DWG. NO. 202-2-1



SECTION A-A (TYPICAL INTERIOR SECTION)
SCALE 3/8"=1'-0"



SECTION THRU WALL
TYP. @ INT. WALLS & SOUTH END WALL
SCALE 3/8"=1'-0"



⚠ SECTION DD-DD

NOTES:
1. FOR CONCRETE GENERAL NOTES SEE DWG. 202-1

AS-BUILT

CONTRACT MC-100

APPROVED:
COASTAL INDUSTRIAL WATER AUTHORITY
BY: Robert B. Lanier PRESIDENT
DATE: DEC 2-1968

COASTAL INDUSTRIAL WATER AUTHORITY OF TEXAS

TRINITY WATER CONVEYANCE SYSTEM FOR THE CITY OF HOUSTON, TEXAS

PHASE I

RIVER PUMP STATION-INTAKE STRUCTURE

WALL SECTIONS

BROWN & ROOT, INC.
Engineers - Constructors
HOUSTON, TEXAS

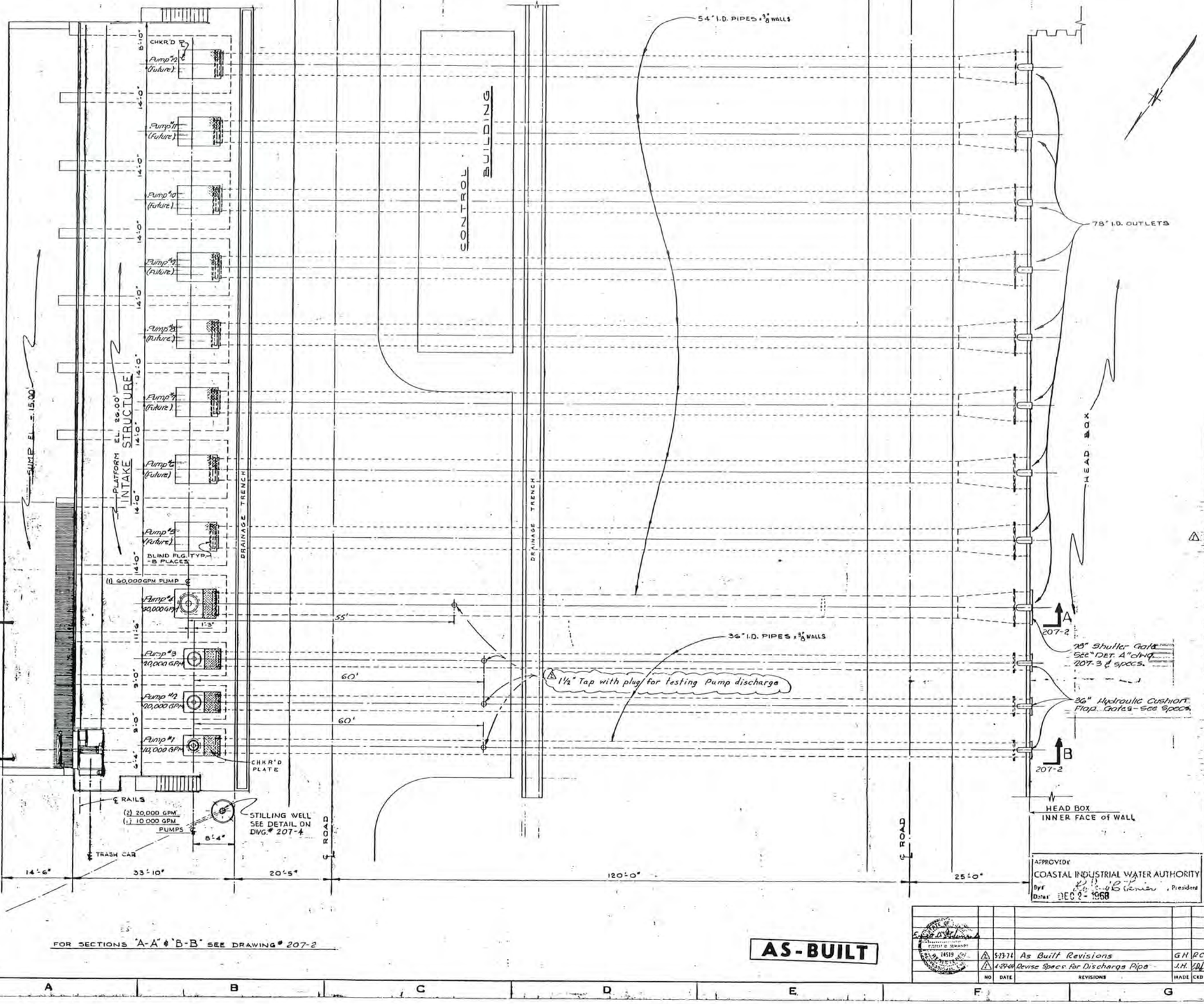
DESIGNED E.D.S	B&R APPROVAL		DATE 4/30/68
DRAWN J.R.S.	CITY OF HOUSTON APPROVAL		DATE 4/29/68
CHECKED E.D.S.	JOB NO. E-746	SCALE AS SHOWN	DWG. NO. 202-4-1

NO	DATE	REVISIONS	MADE	CKD
⚠1	5-21-74	AS BUILT REVISIONS	GH	RC

ORIGINAL DRAWING SIZE IS 40" x 27" HOWEVER. THIS DRAWING WAS REDUCED TO 34" x 22.95". THEREFORE THE SCALE DOES NOT APPLY.

THIS DRAWING FOR INFORMATION PURPOSES ONLY

ALL DIMENSIONS AND DETAILS REQUIRED FOR THE WORK UNDER THIS CONTRACT SHALL BE FIELD VERIFIED



FOR SECTIONS 'A-A' & 'B-B' SEE DRAWING # 207-2

AS-BUILT

GENERAL NOTES-(MECHANICAL)

1. Pipe shall be fabricated in accordance with the applicable AWWA standards.
2. The 36 inch I.D. pipe and the 54 inch. I.D. pipe shall conform to A.W.W.A. standards C-201 or C-202 for A.P.I. 5L grade x-42 pipe.
3. Field welds shall be lap type, double full fillet welded to conform with AWWA Standards C-206.
4. For interior & exterior pipe coating see specifications.
5. At Dresser Coupling, grind weld flush for 2'0" to receive coupling.
6. Flange welds shall conform to AWWA Standard C-207, Section 10.
7. For Intake Structure Pumps see specifications.
8. Concrete for thrust blocks shall be Class "A" (min 3000 psi @ 28 days).
9. Reinf. for thrust blocks shall be intermediate grade deformed bars conforming to ASTM A-15 deformations shall conform to ASTM A-305.
10. See dwg. 201-1 for pipe bedding detail.

CONTRACT MC - 100

COASTAL INDUSTRIAL WATER AUTHORITY OF TEXAS

TRINITY WATER CONVEYANCE SYSTEM FOR THE CITY OF HOUSTON, TEXAS

PHASE I

RIVER PUMP STATION-INTAKE STRUCTURE DISCHARGE PIPING & TRASH RAKE-PLAN

APPROVED: COASTAL INDUSTRIAL WATER AUTHORITY By: [signature], President. Date: DEC 2 - 1968

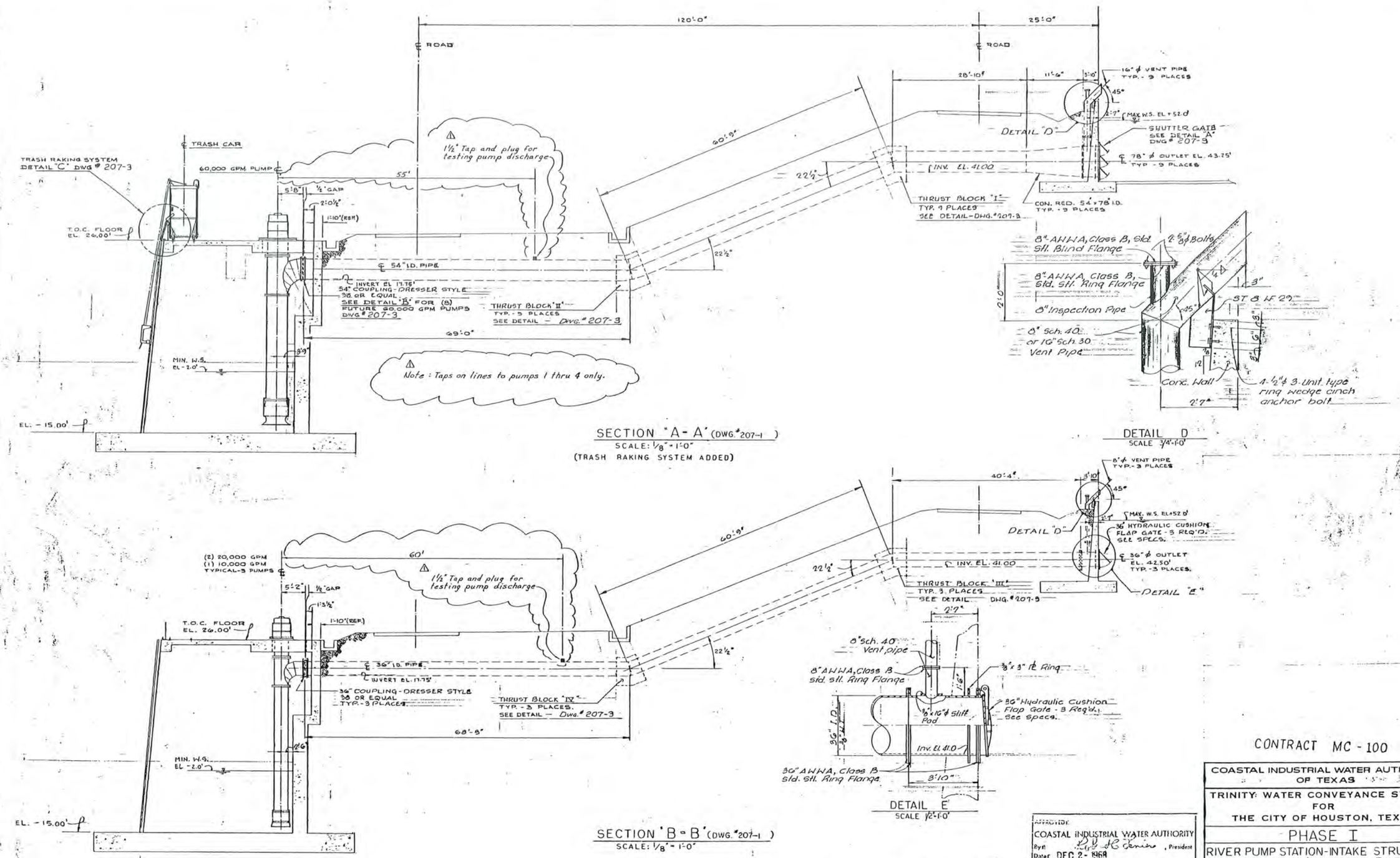
BROWN & ROOT, Inc. Engineers - Consultants HOUSTON, TEXAS

NO	DATE	REVISIONS	MADE	CKD
2	5-23-74	As Built Revisions	G.H.	RC
1	4-29-68	Revise Specs for Discharge Pipe	J.H.	GH

DESIGNED JMO | DRAWN BELANGER | CHECKED JMO | JOB NO E-746 | SCALE 1/8" = 1'-0" | DWG. NO. 207-1-2

BAR APPROVAL [signature] DATE 12/2/68

CITY OF HOUSTON APPROVAL [signature] DATE 12/2/68



CONTRACT MC - 100

COASTAL INDUSTRIAL WATER AUTHORITY
OF TEXAS

TRINITY WATER CONVEYANCE SYSTEM
FOR
THE CITY OF HOUSTON, TEXAS

PHASE I

RIVER PUMP STATION-INTAKE STRUCTURE
DISCHARGE PIPE & TRASH RAKE-SECTIONS

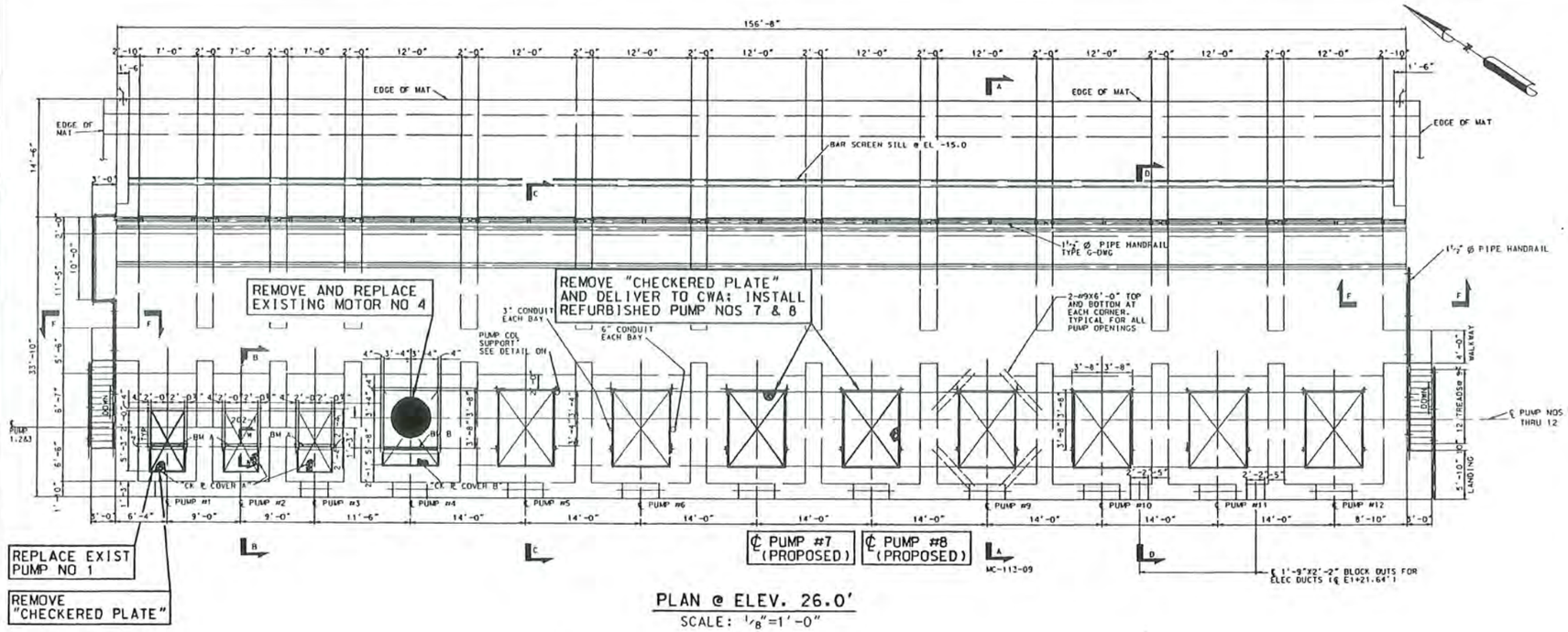
BROWN & ROOT, Inc.
Engineers - Consultants
HOUSTON, TEXAS

APPROVED:
COASTAL INDUSTRIAL WATER AUTHORITY
By: D. V. H. Conner, President
Date: DEC 2 - 1968

NO	DATE	REVISIONS	MADE	CKD
1	3-21-74	As Built Revisions	GH	RC

AS-BUILT

DESIGNED JMO	BAR APPROVAL H.R. Berman	DATE 12/6/68
DRAWN BÉLANGER	CITY OF HOUSTON APPROVAL	DATE 11/15/68
CHECKED JMO		
JOB NO E-746	SCALE NOTED	DWG. NO. 207-2-1



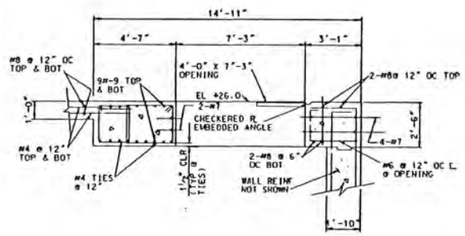
PLAN @ ELEV. 26.0'

SCALE: 1/8"=1'-0"

GENERAL NOTES-(INTAKE STRUCT. CONC)

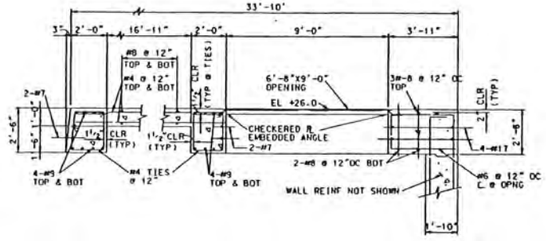
1. ALL CONC. SHALL BE CL."A" (MIN.3,000 PSI @ 28 DAYS) EXCEPT AS NOTED BELOW
2. CONC. FOR MAT SHALL BE CL."C"(MIN. 4,000 PSI @ 28 DAYS)
3. REINF. STEEL SHALL BE INTERMEDIATE. GRADE DEFORMED BARS CONFORMING TO ASTM A-15 UNLESS NOTED OTHERWISE. DEFORMATIONS SHALL CONFORM TO ASTM A-305.
4. REINF. STEEL ON DRAWINGS DESIGNATED AS (A-432) SHALL CONFORM TO ASTM SPEC. A-432
5. REINFORCING SPLICES:
   A. SPLICES IN VERTICAL WALL REINF. SHALL BE MADE OF LOCATIONS SHOWN ON THE DWGS.
   B. NO SPLICES WILL BE PERMITTED IN MAT TRANSVERSE REINF. SPLICE LONGITUDINAL REINF. @ MAT CONST. JOINTS UNLESS SHOWN OTHERWISE.
   C. MAIN REINF. IN SLAB @ EL.+26.0 & WALKWAY SLAB @ EL.+16.5' WHEN SPLICED SHALL HAVE SPLICES LOCATED AS FOLLOWS: SPLICE TOP REINF. AT MID-SPAN; SPLICE BOTTOM REINF. AT WALL SUPPORT.
   D. LONGITUDINAL REINF. IN HORIZ. WALKWAY BEAM @ EL. +10.0 WHEN SPLICED SHALL HAVE SPLICES LOCATED AS FOLLOWS: SPLICE OUTSIDE FACE REINF. AT MID-SPAN; SPLICE INSIDE FACE REINF. AT WALL SUPPORTS.
   E. HORIZONTAL WALL REINFORCING AT 1'-10" BACKWALL SHALL BE SPLICED AT WALL VERT. CONST. JT. AS SHOWN ON DWG. 202-7.
6. MINIMUM COVER FOR REINF. UNLESS OTHERWISE NOTED SHALL BE AS FOLLOWS:
   MAT - BOT. REINF. 4 1/2"
   MAT - TOP REINF. 4"
   ALL OTHERS - 2 1/2"
7. ALL EXPOSED EDGES OF CONC. SHALL HAVE A 3/4" CHAMFER UNLESS OTHERWISE NOTED.
8. DESIGN LIVELOAD ON CONC. AREAS @ EL. 26.0 = 200 P.S.F.
   DESIGN LIVELOAD ON CK. R AREAS @ EL. 26.0=100 P.S.F.
9. REINFORCING LAP LENGTHS AT SPLICES SHALL BE AS SHOWN ON THE DWGS. LAP LENGTHS NOT NOTED OR SHOWN SHALL BE 30 BAR DIA. MINIMUM.

FOR CONC. SURFACE FINISHES SEE SPECIFICATIONS



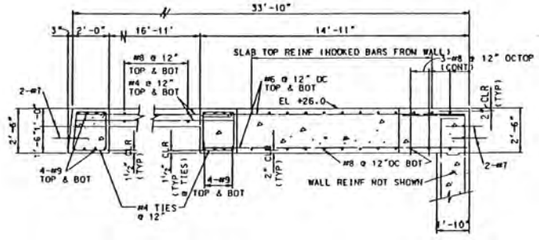
SECTION B-B

SCALE: 1/4"=1'-0"



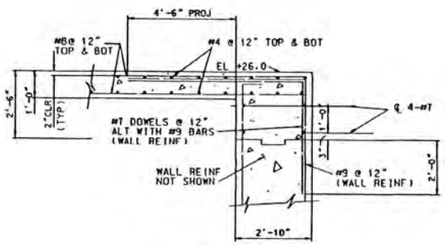
SECTION C-C

SCALE: 1/4"=1'-0"



SECTION D-D

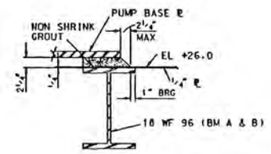
SCALE: 1/4"=1'-0"



SECTION F-F

SCALE: 3/8"=1'-0"

STRUCTURAL INFORMATION SHOWN FOR REFERENCE



SECTION W-W

SCALE: 3/4"=1'-0"

AS-BUILT

NOTICE: AS-BUILT INFORMATION SHOWN ON THIS DRAWING WAS DEVELOPED FROM INFORMATION PROVIDED BY CONTRACTOR, SUPPLIERS AND OTHERS. USER MUST VERIFY ACCURACY OF INFORMATION PRIOR TO USE. BROWN & ROOT, INC. AND/OR THE COASTAL WATER AUTHORITY MAKE NO WARRANTY AS TO THE ACCURACY OF THE INFORMATION SHOWN.

PROPOSED WORK SHOWN IN BOLD

STATE OF TEXAS — GLENN G. HUGHES — 83130 — REGISTERED PROFESSIONAL ENGINEER — 5-14-98

REV NO	DESCRIPTION	APP'D	DATE
1	AS BUILT- NO CHANGES	G.G.H.	5-19-00

COASTAL WATER AUTHORITY OF TEXAS

TRINITY WATER CONVEYANCE SYSTEM FOR THE CITY OF HOUSTON

CONTRACT NO. MC-113

TRINITY RIVER PUMP STATION PUMP BAY NOS 1, 7, AND 8 PLAN AND SECTIONS

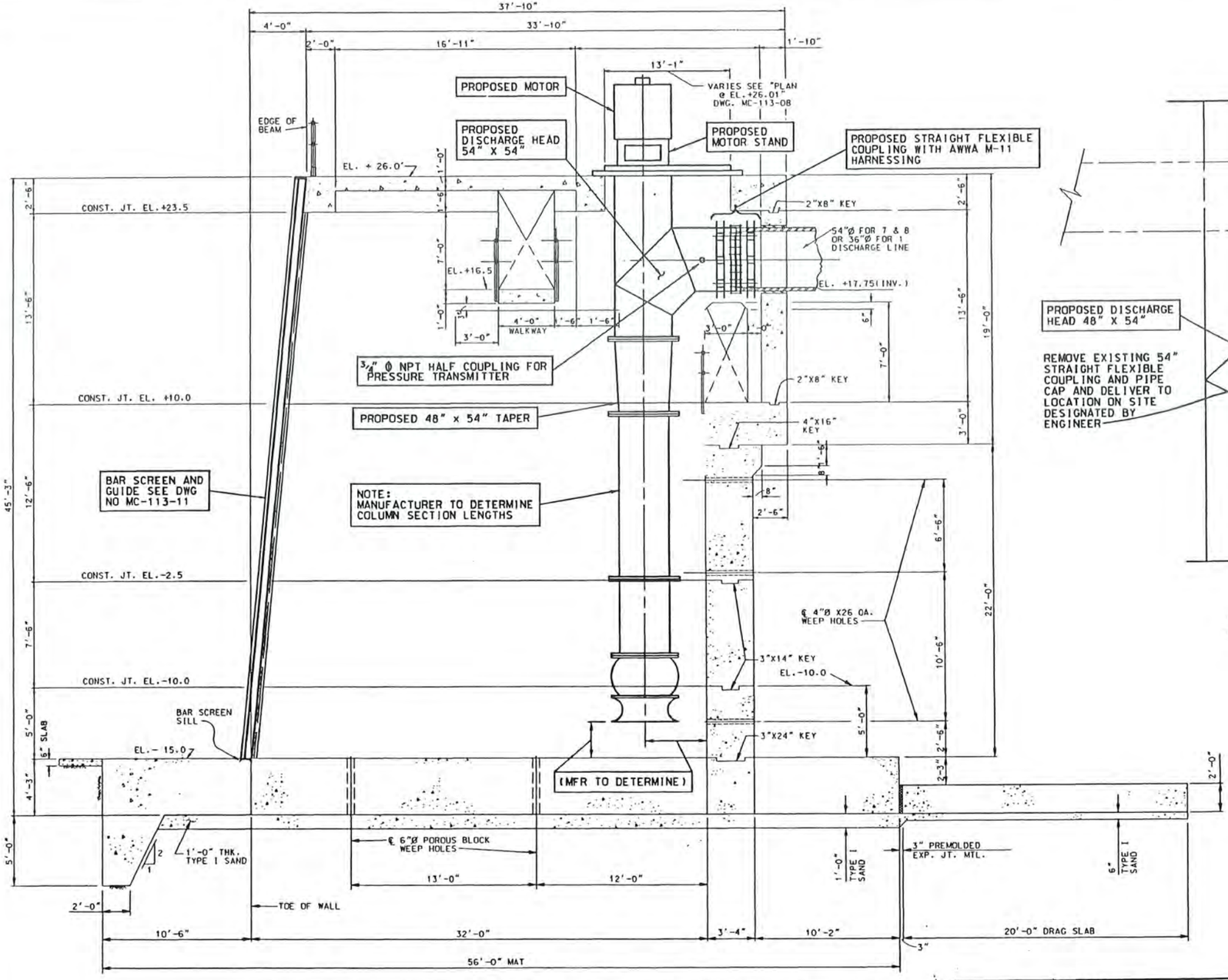
Brown & Root, Inc.
Engineers . Consultants
HOUSTON, TEXAS

DESIGNED RES	DRAWN JAG	CHECKED GGH	
JOB NO CM-0041	B&R APPROVAL		DATE 5-28-98
CITY APPROVAL			DATE 5-29-98
CWA APPROVAL			DATE 5-28-98
SCALE AS SHOWN		DWG NO MC-113-08-01	

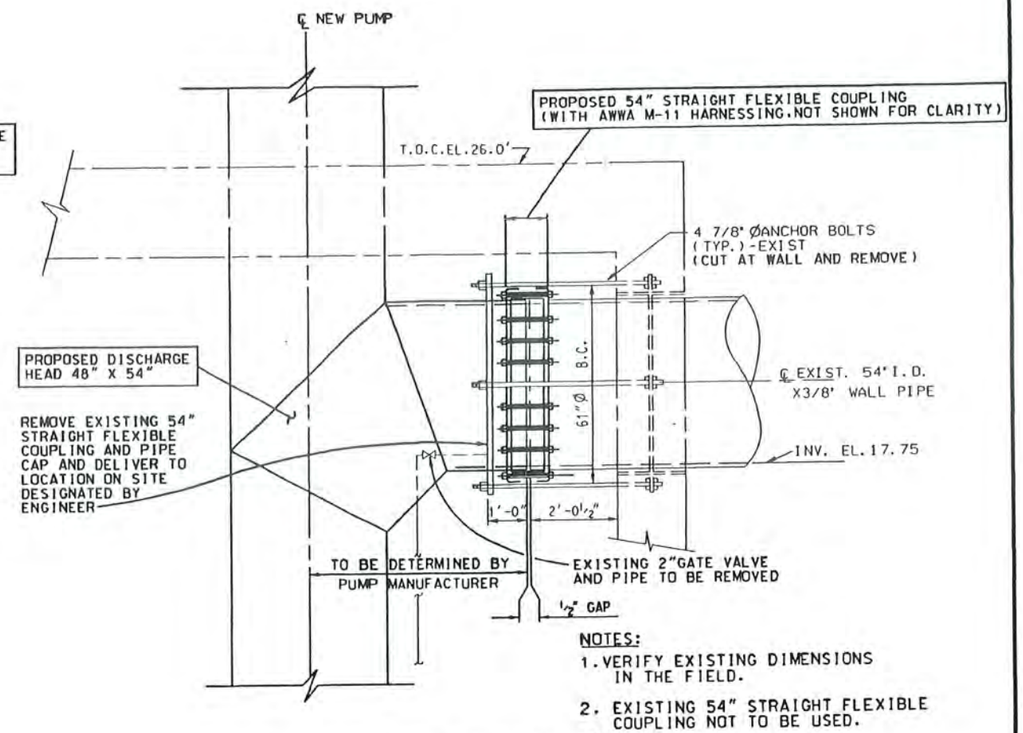
CADD DWG FILE NO : MC11308.DGN-04

0 1 2 3 ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

BAR_HO_ESOS /HCIVIL/CM0041/ RF=CM0041.BOR LVS ON=1-59,61-63



SECTION A-A (PROPOSED PUMP NO 8 SHOWN, NO 7 IDENTICAL, NO 1 SIMILAR)
SCALE: 1/4"=1'-0"



NOTES:
1. VERIFY EXISTING DIMENSIONS IN THE FIELD.
2. EXISTING 54" STRAIGHT FLEXIBLE COUPLING NOT TO BE USED.

EXISTING / PROPOSED PUMP DISCHARGE CONNECTION
SCALE: 1/2"=1'-0"

AS-BUILT
NOTICE: AS-BUILT INFORMATION SHOWN ON THIS DRAWING WAS DEVELOPED FROM INFORMATION PROVIDED BY CONTRACTOR, SUPPLIERS AND OTHERS. USER MUST VERIFY ACCURACY OF INFORMATION PRIOR TO USE. BROWN & ROOT, INC. AND/OR THE COASTAL WATER AUTHORITY MAKE NO WARRANTY AS TO THE ACCURACY OF THE INFORMATION SHOWN.

PROPOSED WORK SHOWN IN BOLD

COASTAL WATER AUTHORITY OF TEXAS

TRINITY WATER CONVEYANCE SYSTEM FOR THE CITY OF HOUSTON

CONTRACT NO. MC-113

TRINITY RIVER PUMP STATION PUMP BAY NOS. 1, 7, AND 8 SECTION

Brown & Root, Inc.
Engineers . Consultants
HOUSTON, TEXAS

DESIGNED	RES	DRAWN	JAG	CHECKED	GGH
JOB NO	CM-0041	B&R APPROVAL		DATE	5-28-98
CITY APPROVAL				DATE	5-29-98
CWA APPROVAL				DATE	6-28-98
SCALE	1/4"=1'-0"			DWG NO	MC-113-09-01

REV NO	DESCRIPTION	APP'D	DATE
1	AS BUILT - NO CHANGES	G.G.H.	5-19-00

E.E.I.P. STATE OF TEXAS GLENN G. HUGHES 68190 REGISTERED PROFESSIONAL ENGINEER

CADD DWG FILE NO : MC11309.DGN-08

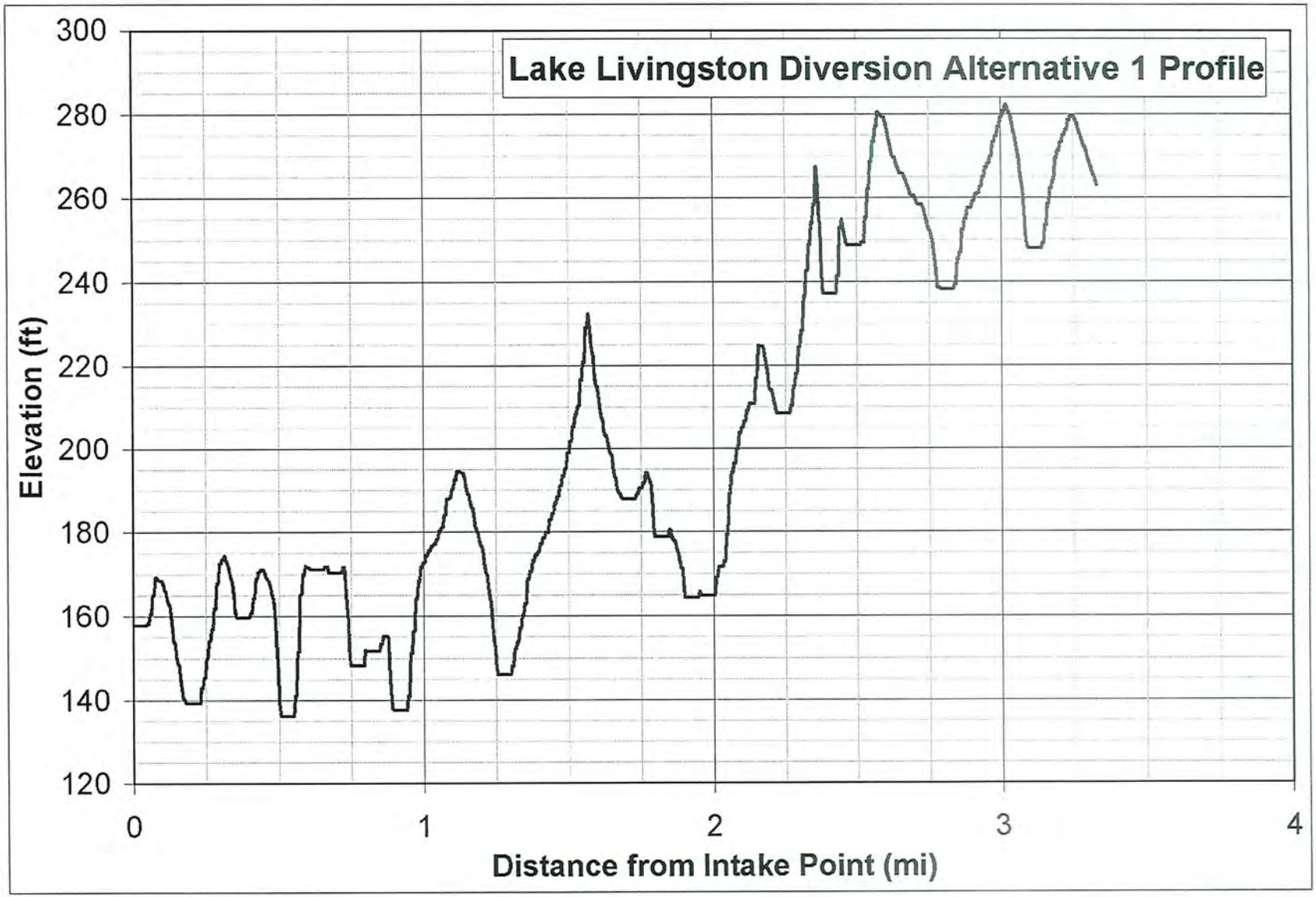
0 1 2 3 ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

BAR_HO_ES05 /HCIVIL/CM0041/ RF=CM0041.BOR LVS ON=1-59,61-63

Appendix B

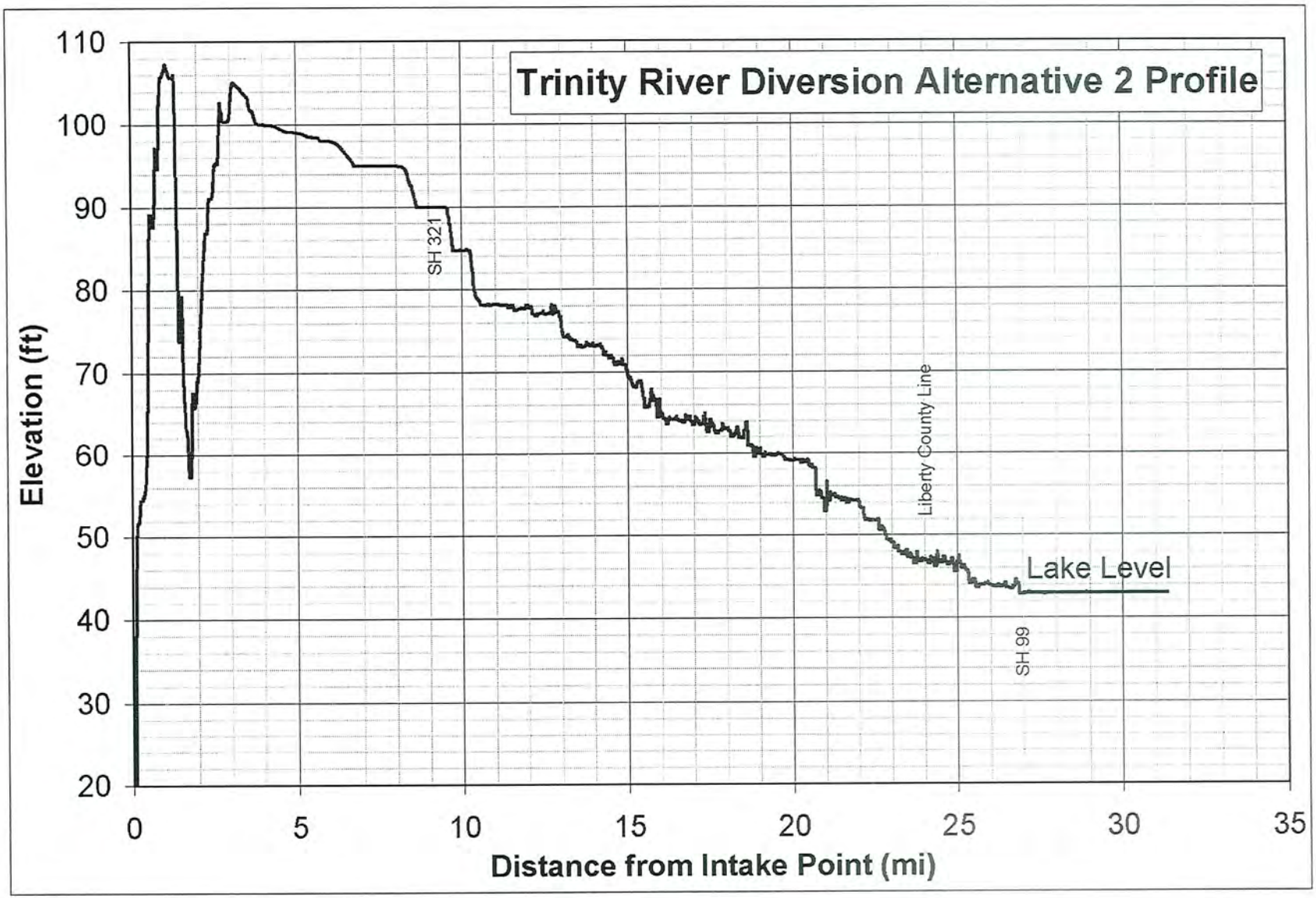
Section 7

Luce Diversion Profile Option 1 – Alternative 1



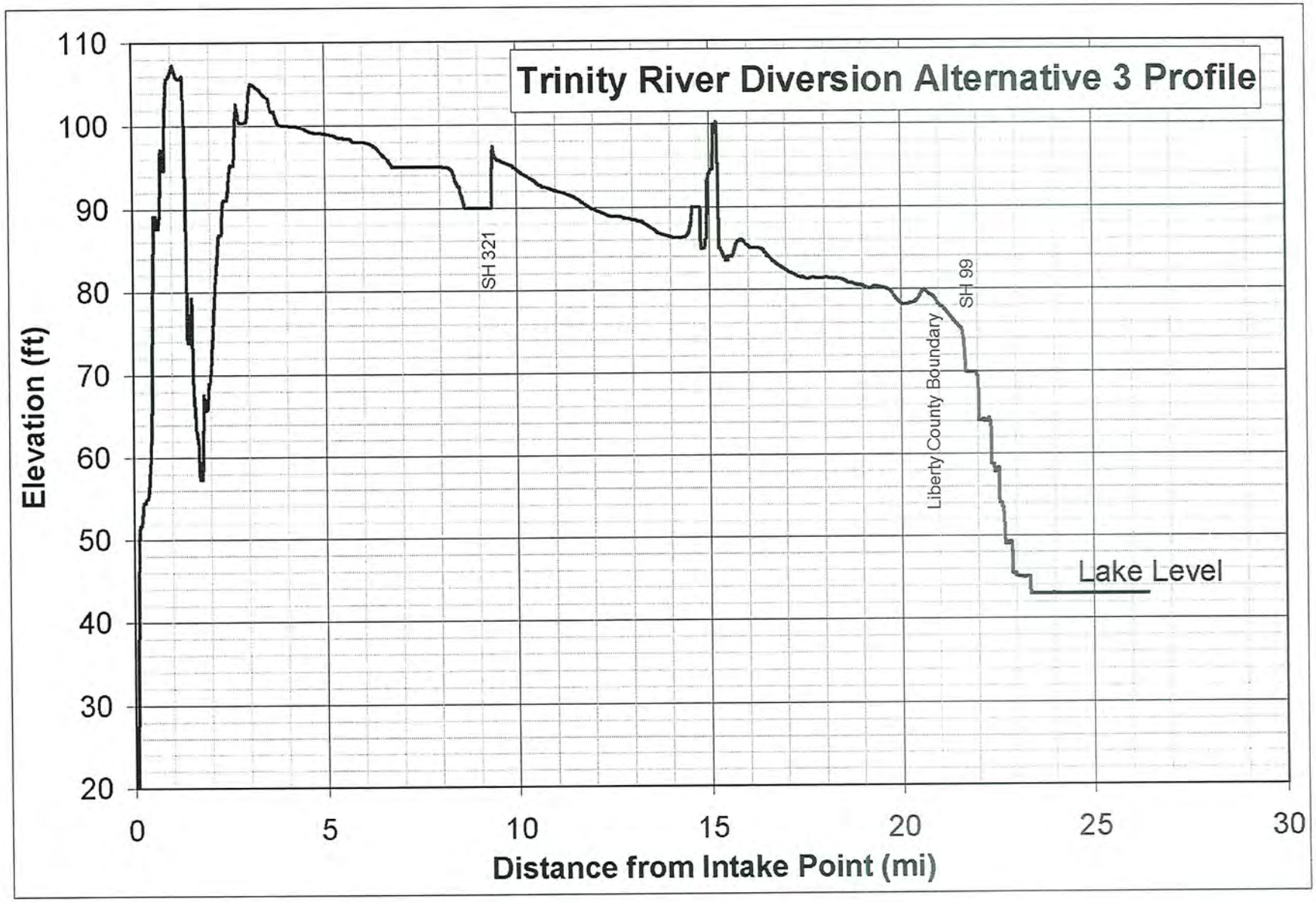
TCB | AECOM

Luce Diversion Profile Option 1 – Alternative 2



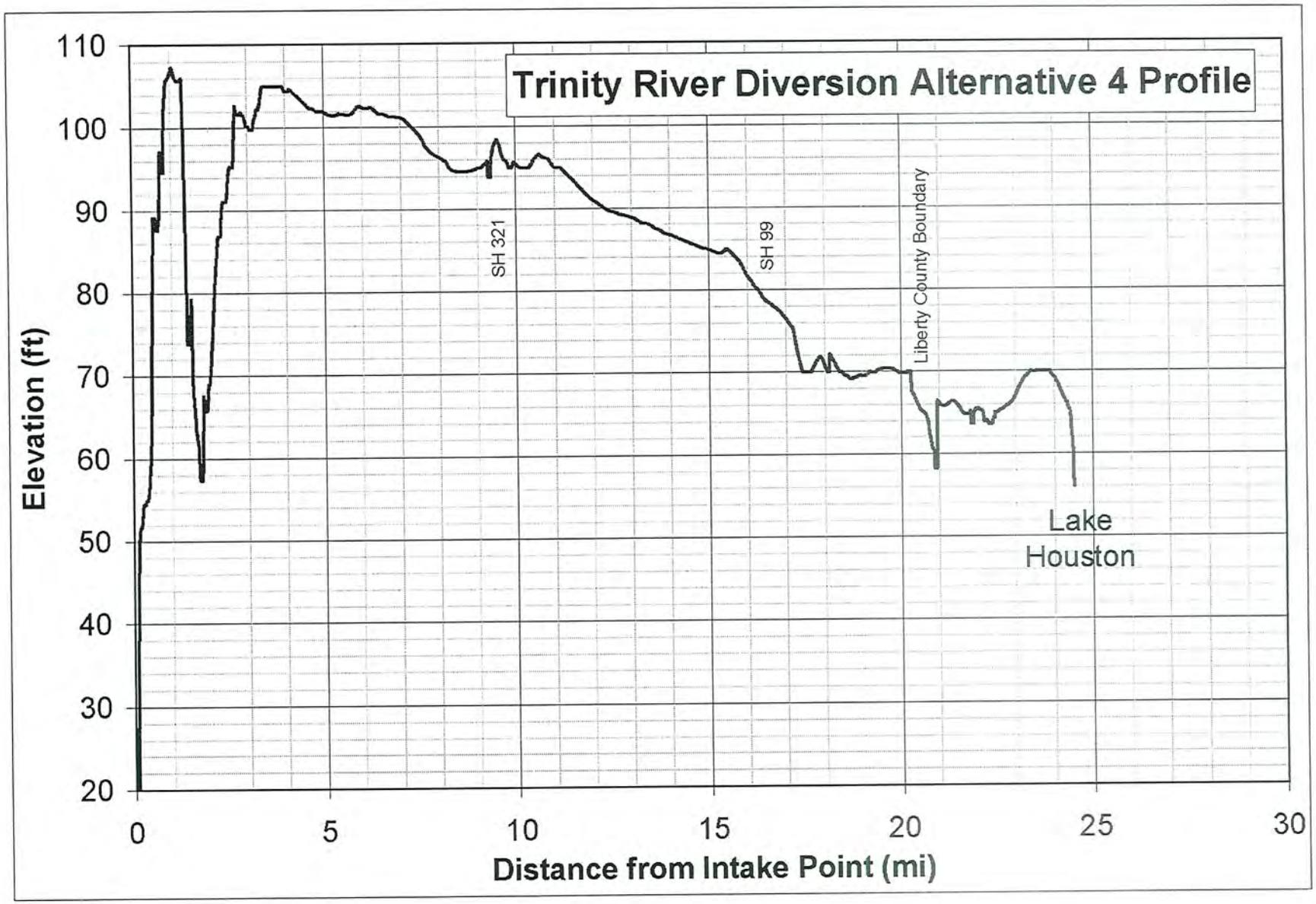
TCB | AECOM

Luce Diversion Profile Option 1 – Alternative 3



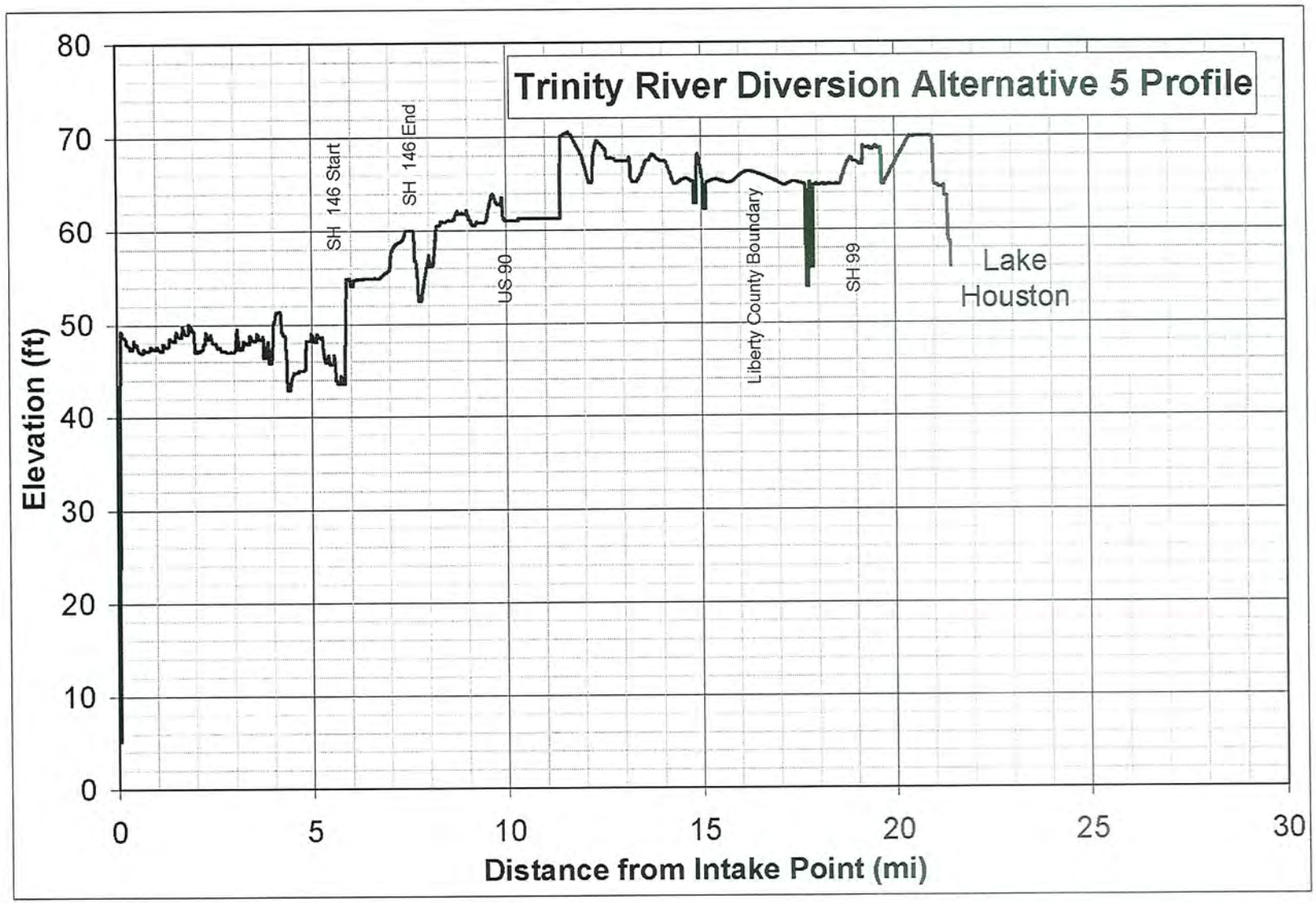
TCB | AECOM

Luce Diversion Profile Option 1 – Alternative 4

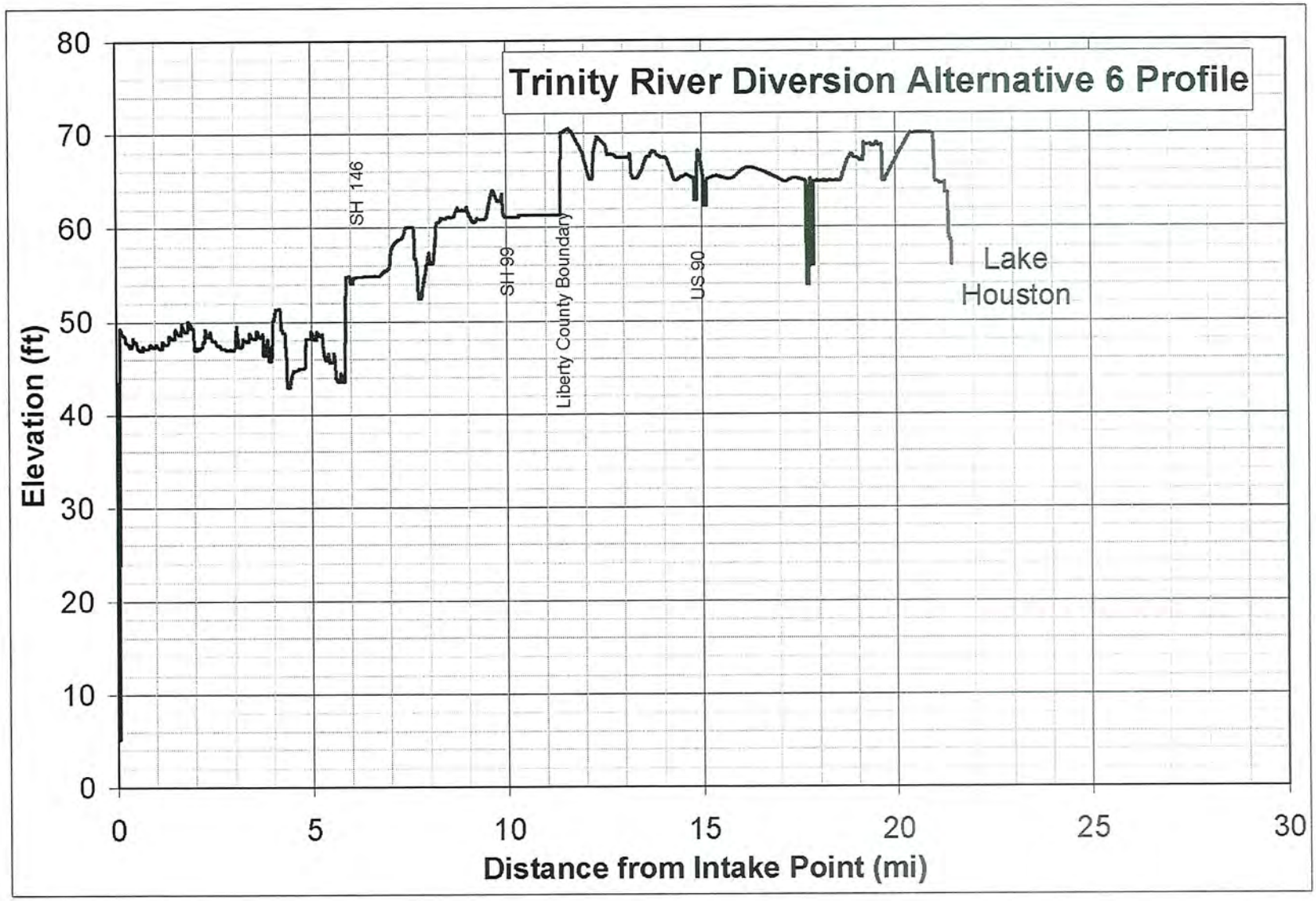


TCB | AECOM

Luce Diversion Profile Option 1 – Alternative 5



Luce Diversion Profile Option 1 – Alternative 6

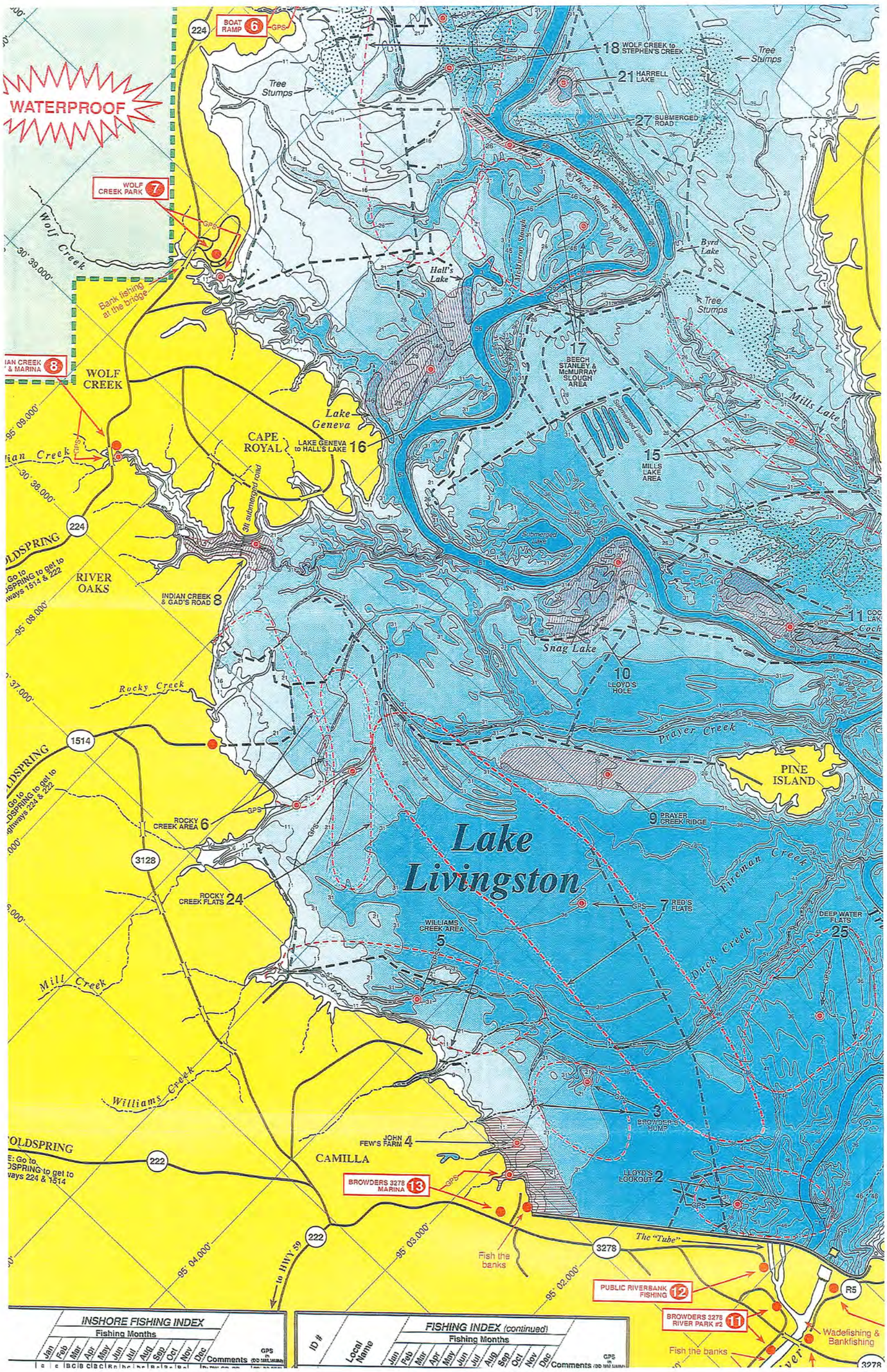


TCB | AECOM

Appendix B

Section 8

Freshwater Fishing Map



Source: Hook-N-Line Map Company, Inc., Freshwater Fishing Map (Map Number F106), Lake Livingston, Texas

Appendix C – Agency Meeting Minutes

TCB
5757 Woodway Drive, Suite 101W, Houston, Texas 77057-1599
T 713.780.4100 F 713.780.0838 www.tcb.aecom.com

Meeting Minutes

Subject:	Texas Parks and Wildlife Department Luce Bayou Conceptual Mitigation Coordination
Project reference:	Luce Bayou Interbasin Transfer Project TCB Job No. 60003747-11001
Place:	2 South Conference Room TCB Inc. Office
Meeting date:	Tuesday, August 22, 2006 at 1 p.m.
Attendees:	Woody Woodrow, TPWD Lucia Lee, KBR Anne Profilet, EcoLogic Mike Reedy, TCB Patty Matthews, TCB Kelly Krenz, TCB Ron Kelling, TCB Roy Knowles, TCB
Date prepared:	Friday, August 25, 2006
Prepared by:	Kelly Krenz, PG

I. Introductions

Woody Woodrow was introduced to the Luce Bayou project team of TCB and KBR. Mr. Woodrow is the Upper and Lower Coast Aquatic Conservation Program Leader with the Habitat Resources Division of the Texas Parks and Wildlife Department and has an office at the Coastal Fisheries office in Dickinson, Texas (1502 FM 517 East). His telephone number is 281-534-0131.

II. Luce Bayou Alternatives—Ron Kelling

Six main project alternatives for providing water from the Trinity River to Lake Houston were described and discussed. The main alternatives include components that would convey water either to Lake Houston or directly to the NE Water Purification Plant (NEWPP). The GIS map showing the alternatives was an infrared aerial photograph background with NWI wetlands and FEMA floodplain data. The alternatives and some engineering issues for each alternative corridor are briefly summarized below:

Alternative 1: Lake Livingston point of diversion (POD), pump to Sand Creek via pipeline, Sand Creek to East Fork San Jacinto River to Lake Houston. Issues to consider:

- Capacity of Sand Creek
- Capacity of the East Fork San Jacinto River

- Seepage, evaporation losses and erosion along Sand Creek and East Fork San Jacinto River (approximately 30 or so miles downstream to Lake Houston)
- Existing residential development and the location of the pump station
- Water quality

Alternative 2: Luce Bayou "Traditional" project. Capers Ridge POD, construction of new pipeline and pump water over ridge to constructed canal, canal to Luce Bayou, Luce Bayou to Lake Houston. Issues to consider:

- New pipeline alignment over ridge to canal
- New canal section
- Capacity of Luce Bayou
- Seepage and evaporation losses, increased erosion along proposed canal section and Luce Bayou
- Water quality

Alternative 3: Capers Ridge POD, pump over ridge to canal, extend canal south of Luce Bayou to Lake Houston. Issues to consider:

- New pipeline alignment over ridge to canal
- New canal section to Lake Houston
- Seepage and evaporation losses, increased erosion along proposed canal section
- Water quality

Alternative 4: Capers Ridge POD, pump over ridge then along HNG pipeline easement to point south of FM 1960, then along Sunoco pipeline easement to Lake Houston. Issues to consider:

- New pipeline over ridge and to Lake Houston
- Development along route
- Water quality

Alternative 4a: Capers Ridge POD, install new pipeline, pump over ridge then along HNG pipeline to point south of FM 1960, then along Sunoco pipeline easement to Lake Houston, pipeline under Lake Houston, pipeline directly to NEWPP. Issues to consider:

- New pipeline over ridge extending to Lake Houston
- Existing and proposed development along route
- Installation of line under Lake Houston

Alternative 5: Trinity River Pump Station (TRPS) POD, modifications to TRPS, gravity along improved Dayton Canal to point south of Highway 90, new pump station, pump through new pipeline to Lake Houston along Reliant Energy power line easement. Issues to consider:

- Potential limited capacity of Dayton Canal
- Pipeline from south of Highway 90 to Lake Houston
- Construction and cost of two pump stations
- Water quality

Alternative 5a: TRPS POD, modifications to TRPS, gravity along improved Dayton Canal to point south of Highway 90, pump station, pump through new pipeline to Lake Houston along Reliant Energy power line easement, pipeline under Lake Houston, pipeline directly to NEWPP. Issues to consider:

- Potential limited capacity of Dayton Canal
- Pipeline from south of Highway 90 under Lake Houston to NEWPP

Alternative 6: TRPS POD, modifications to TRPS, pump through new pipeline along Mobil pipeline easement to Lake Houston. Issues to consider:

- Pipeline from TRPS to Lake Houston
- Existing area development (Newport subdivision)
- Water quality

Alternative 6a: TRPS POD, modifications to TRPS, pump through new pipeline along Mobil pipeline corridor to Lake Houston, pipeline beneath Lake Houston Dam, pipeline directly to NEWPP. Issues to consider:

- Pipeline from TRPS to Lake Houston
- Existing area development (Newport subdivision)
- Installation issues of pipeline beneath Lake Houston

III. Luce Bayou Mitigation Concepts—Woody Woodrow, TPWD

Luce Bayou begins in northwestern Liberty County and flows southwesterly to Lake Houston. The bayou is narrow and shallow in its upper reaches, but widens and deepens downstream. The USGS, in cooperation with HGAC, collected stream-habitat and benthic macroinvertebrate data for Luce Bayou and other streams near Houston to assess stream habitat and biological integrity (USGS Water Resources Investigation Report 01-4010). Luce Bayou exhibited the highest stream-habitat integrity score and the second highest biological integrity score of all the streams studied in the Houston area. The study found that stream reaches with higher stream-habitat and biological integrity scores correlate with areas that are heavily-forested with fewer people per square mile.

Luce Bayou is an ecologically valuable stream in the Houston area, with portions that are and portions that will be subject to development pressures that could cause stream and water quality degradation with resultant impacts to biological resources. Standard resource and regulatory agency response to projects such as this include the recommendation to (1) avoid environmental impacts, (2) minimize impacts, and (3) compensate. This project presents an opportunity for partnership to address multiple public needs including habitat conservation. It affords an opportunity to provide protection to the Luce Bayou watershed by providing a mechanism for habitat protection, enhancement, or restoration by incorporating stream preservation concepts implemented through conservation easements or other protective covenants. An overarching goal would be the establishment of a conservation corridor that could protect Luce Bayou from anticipated land use changes that serves water supply needs, watershed protection, fish and wildlife resources, and recreation.

Stream preservation concepts for this project could include protection of the natural vegetation along Luce Bayou, minimization of ground disturbance, and incorporation of principals of fluvial geomorphology (Rosgen's Stream Restoration Techniques) to establish a stable stream equilibrium. If the channel requires widening to accommodate increased projected flows, it can be restored with vegetation and its characteristic physical attributes such as pool and riffle habitats. These types of channels may also be easier to maintain from an operations perspective than a typical canal or channelized reach that requires mowing and maintenance of slope failures.

Construction of a parallel overflow channel or enhancement of the natural channel system may also be beneficial with respect to the regulatory/resource agency permitting and consultation process. The concept described for the Luce Bayou project could result in the development of a linear greenbelt corridor that could provide opportunities for recreation or could serve as a natural area for Liberty County and Houston area residents. The Luce Bayou project could provide environmental preservation components that could enhance area aesthetics and property values. Potential stakeholders and sponsors could be area residents, local landowners, local, state, and federal resource agencies, and non-profit groups such as Trust for Public Land, Conservation Fund, Legacy Land Trust, Liberty County, river restoration groups, etc. Glenn Laird of Harris County Flood Control District and Dennis Johnson of Harris County Precinct 4 may provide some insights into stream restoration and stream corridor conservation initiatives and funding. The TPWD is not in a position now to provide support in terms of funding. Temple Inland may own some property in the Luce Bayou corridor area. Grant opportunities with federal and local matching funds could be identified and investigated. TPWD can do "pass through" funding such as under the National Wetlands grant program and the TPWD has provided funding through the Grants-in-Aid Program to cities and counties for parks.

Concerns expressed by Woody Woodrow regarding the described alternatives for the Luce Bayou project (other than those described above) include the following:

- An analysis of the threat of invasive species should be perfomed to determine the additive risk of introductions across watersheds. The additive risk may be low as most species of concern already occur in both watersheds.
- Shallow groundwater recharge zones or areas along the East Fork of the San Jacinto River.
- Changes to fluvial geomorphology and resultant siltation caused by bank failures or scouring (erosion) areas caused by changes to the energy of the channel.
- As necessary, compensatory mitigation and associated costs for a 50-year timeframe would need to consider direct habitat degradation or changes to long-term habitat function and value; the timing and duration of restoration effects that would occur after mitigation efforts are completed; restoration planning, implementation, maintenance, and monitoring; and, loss of habitat productivity until restoration is accomplished.
- Alternative 1 (Lake Livingston to Sand Creek): Water quality impacts caused by fluctuating lake levels in Lake Livingston. If this alternative would require a water rights permit amendment, TPWD would recommend that environmental flows be incorporated into the permit conditions.
- Compensation by land preservation and/or large-scale habitat restoration are preferable alternatives for the replacement of unavoidable impacts.

Action Items

1. TCB to prepare meeting minutes.
2. Woody Woodrow to e-mail jpeg file with HGAC's transportation mobility plan for the area.
3. Contact with Dennis Johnson (Harris County Precinct 4) and Glenn Laird (HCFCD) to discuss stream preservation concepts.
4. TCB to strategize about contacting the USFWS (Moni Belton) with Anne Profilet.
5. Discuss at September 5, 2006 progress meeting.

TCB
5757 Woodway Drive, Suite 101W, Houston, Texas 77057-1599
T 713.780.4100 F 713.780.0838 www.tcb.aecom.com

Meeting Minutes

Subject:	U.S. Fish and Wildlife Service Luce Bayou Project Meeting
Project reference:	Luce Bayou Interbasin Transfer Project TCB Job No. 60003747-11001
Place:	USFWS Clear Lake Office
Meeting date:	Tuesday, September 26, 2006 at 9:30 am
Attendees:	Moni Belton, USFWS Catherine Yeargan, USFWS Anne Profilet, EcoLogic Kelly Krenz, TCB
Date prepared:	Friday, September 29, 2006
Prepared by:	Kelly Krenz, PG

I. Introduction and Luce Bayou Project Description

Moni Belton and Catherine Yeargan (USFWS) were introduced to the Luce Bayou project and to Anne Profilet (EcoLogic) and Kelly Krenz (TCB).

The Luce Bayou Interbasin Transfer project has been in the planning phases for many decades. The project includes the transfer of raw surface water from the lower Trinity River basin to Lake Houston in the San Jacinto River basin. The project - as previously defined - used Luce Bayou, located in Liberty and Harris counties, for a portion of the conveyance system. The Coastal Water Authority is implementing Phase I of the implementation of the project. Phase I generally involves environmental permitting, preliminary engineering, and initial land acquisition activities.

The establishment of the City of Houston (COH) Water Purification Plant below Lake Houston was planned to allow the plant to process water from Lake Houston to supply the city's water demands. A system to transport water by way of Luce Bayou was originally planned as the sole conveyance of water from the Trinity River basin to the COH water system by way of Lake Houston. In February 1973, Brown & Root, Inc. published a preliminary engineering report on the Luce Bayou Diversion Project. That report outlines the plan and cost for a river pump station and conveyance facility which was to Trinity River water through Luce Bayou into Lake Houston. This plan consisted of two phases; the first was to involve the following activities:

- Construction of the pump station including pumps required for a 200 million gallon per day (MGD) capacity
- Construction of 20,000 foot (96 inch) pipeline for the conveyance facility
- Construction of 14,000 foot canal designed for the ultimate flow rate

- Rectification of 35,000 feet along Luce Bayou
- Construction of necessary infrastructure (access road, operator's residence, electric power lines fences)

The second phase of the project is to begin when the demand exceeded the initial pumping capacity of the conveyance facility, as constructed during the first phase. The second phase is projected to include the following activities:

- Instillation of additional pumps for and ultimate capacity of 400 MGD
- Addition of approximately 16,000 foot (96 inch) pipeline

The ultimate project would include the diversion of 400 million gallons of water per day from the Trinity River to Lake Houston. The City of Houston holds a water rights permit to divert this water from the Trinity River and also has identified a pump station site at Capers Ridge, a topographic high point that extends roughly east-west from the Trinity River further east of Luce Bayou.

II. Luce Bayou Practicable Alternatives

The practicable project alternatives identified through initial project screening for providing water from the Trinity River to Lake Houston along Luce Bayou were described and discussed. The practicable alternatives are Alternatives 2 and 3, the Luce Bayou "traditional" and a proposed parallel canal south of Luce Bayou. A GIS map was used to facilitate discussions and describe the location of the two practicable alternatives. The map base is the 2004 infrared aerial photograph for the project area and included NWI-mapped wetlands and FEMA floodplain data. The alternatives and some engineering issues for each alternative corridor are briefly summarized below:

Alternative 2: Luce Bayou "traditional" project includes the Capers Ridge point-of-diversion (POD), construction of new pipeline and pump water over ridge to constructed canal, canal section to Luce Bayou, Luce Bayou to Lake Houston. Issues to consider:

- New pipeline alignment over ridge to canal
- New canal section
- Capacity of Luce Bayou

Alternative 3: Capers Ridge POD, pump over ridge to canal, extend canal south of Luce Bayou to Lake Houston. Issues to consider:

- New pipeline alignment over ridge to canal
- New canal section to Lake Houston

III. Luce Bayou Project Issues--USFWS

An Environmental Assessment (EA) will be prepared in support of the Section 404 permit to identify project alternatives, potential impacts, and project compensation. Concerns expressed by the USFWS regarding the Luce Bayou project and the described alternatives for the Luce Bayou project include the following:

- Disturbance of an undisturbed area along the Trinity River (Caper's Ridge) for the pump station site, the operator residence, access roads, power lines, and the location of pump station at the Trinity River. Alternatives analysis should include alternative pump station sites in areas along the river that have already been disturbed. Noise impacts would also be a concern.
- Migratory bird habitat and disturbance that would occur as a result of the project.
- Bald Eagle nesting along the Trinity River and Red-cockaded Woodpecker (RCW) habitat in the project area. The Golden and Bald Eagle Protection Act establishes jurisdiction and regulatory standards for protection. Forested tracts would need to be evaluated for the presence of Bald Eagles. Roost trees, congregation areas, and nests would need to be identified and evaluated. Interviews with local residents are often helpful in this regard.

- The location and impacts to national forest lands and park property as a result of the project.
- Directional drilling of the pipeline would likely be necessary to avoid areas that are sensitive or protected.
- Invasive and exotic species and recruitment of species such as Chinese tallow and *Cyperus entrerianus* (a deeprooted, flat sedge) in cleared areas.
- Water hyacinth is a long-term maintenance issue with channelization but generally not a problem in areas that are shaded with running water.
- Entrapment and entrainment of aquatic species at the pump station.
- Flooding and scouring in Luce Bayou.
- Permanent changes in water levels and alteration of aquatic habitat in Luce Bayou.
- Bottomland hardwood forest impacts and identification of habitat types that may be affected by the project would need to be documented by the EA.
- Threatened and endangered plant species such as Prairie dawn found on Gessner and Addicks soils in cleared areas.
- Compensation for wetland and upland habitat impacts would be recommended with maximum 7:1 ratios for undisturbed forested wetland impacts. Preservation with enhancement with a large tract of land would be preferable to a narrow riparian corridor along Luce Bayou. A large tract of riparian property within the 100-year floodplain would be acceptable in the Luce Bayou or Trinity River watershed. The Trinity River National Wildlife Refuge (TRNWR) (Stuart Marcus 936-336-9786) has established a corridor along the Trinity River with habitat that is earmarked for purchase and protection. These tracts of land are described by the Lower Trinity River Floodplain Habitat Stewardship Program Plan and could be available for compensation. The TRNWR could be helpful and cost-effective in acquiring land for mitigation from local property owners.
- Compensation for the project and any wetlands mitigation would need to be implemented before construction of the Luce Bayou project could occur.
- If consultation under the Endangered Species Act would be necessary, early Section 7 consultation and the development of a Habitat Conservation Plan would be beneficial to all parties to establish agreements, obtain necessary easements, and permits.

Deleted: .

Action Items

1. TCB to prepare meeting minutes.
2. Contact USFWS and obtain the Lower Trinity River Floodplain Habitat Stewardship Program Plan.
3. Identify for future discussion mitigation proposed by TCB in the Luce Bayou area for the Woodlake Village Section 404 permit.
4. Future site visit with the USFWS.
5. Development of an EA that would address the issues and concerns identified.
6. Identification of project-related compensation opportunities.
7. Discussion at the October 2006 progress meeting.

TCB
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Meeting Minutes

Subject	Luce Bayou Interbasin Transfer Meeting with U.S. Army Corps of Engineers
Project reference	Luce Bayou - TCB Project No. 60018609
Place	USACE – Galveston District Offices, Galveston, Texas
Meeting date	November 9, 2006
Attendees	John Machol, USACE; Kristi McMillan, USACE; Lucia Lee, KBR; Anne Profilet, EcoLogic; Ron Kelling, TCB; Kelly Krenz, TCB; Roy Knowles, TCB
Date prepared	November 15, 2006
Prepared by	Roy Knowles
Distribution	Gary Oradat, CWA; Mike Reedy, TCB; Anne Profilet, EcoLogic; Lucia Lee, KBR

Kristi McMillan, who had participated in previous meetings related to the Luce Bayou Interbasin Transfer project, will be moving from the Evaluation Section of the U.S. Army Corps of Engineers to the Compliance Section. John Machol will replace Kristi as the USACE's point of contact for the project.

Following introductions of the meeting attendees, Ron Kelling provided an overview of the project and the alternatives developed to convey up to 400 mgd of Trinity River water into Lake Houston for treatment at the Northeast Water Treatment Plant. Based upon the preliminary evaluation of the alternatives, Alternatives 2 and 3 (conveyance from Capers Ridge pump station through Luce Bayou, and from Capers Ridge pump station through a constructed canal, respectively) were selected as the candidate project alternatives for further development and investigation. The project team informed John and Kristi that a recent site visit with representatives of the USFWS and TPWD revealed that the agencies were not in favor of the Luce Bayou alternative because of the potential adverse environmental impacts to the channel. They prefer the proposed constructed canal alternative south of Luce Bayou.

Two issues John noted were reduced flows in the Trinity River downstream of the point of diversion and potential wetlands impacts for the selected alternative. The project team explained that the City of Houston has water rights to Trinity River water and that water flows in the Trinity River have been addressed in the 2006 Region H Water Plan, which accounts for permitted diversions of water from the river, including the 400 mgd to Lake Houston. There is also an existing pump station downstream of the Capers Ridge diversion point that is currently being expanded. This pump station already transfers City of Houston water from the Trinity River basin to the San Jacinto River basin. Potential wetlands impacts would be assessed during more detailed field investigations of the preferred alternative. The USACE indicated that a functional assessment of the wetlands impacted by the project would need to be performed if potential wetland impacts were found to be

significant. The assessment should incorporate factors such as the acres and types of wetlands impacted (e.g., farmed wetlands). It was also emphasized that the Trinity River is considered a navigable water of the United States northward to the City of Dallas, even though reservoir dams have been constructed in the river channel.

As for project documentation, John indicated that interbasin water transfer projects typically require preparation of an EIS. The project team explained that if the canal alternative is selected, the environmental impacts are anticipated to be relatively small. Because project impacts may be minimal, Anne Profilet asked if the USACE would consider authorization of the project under nationwide permits. John stated that he would like to see what project documentation is submitted to determine how the project may be authorized. He said that secondary impacts could require that the project be evaluated under an individual permit application, which may require the preparation of an EIS. Kristi and John both explained that the project needs to be evaluated at the appropriate level to protect the applicant and the USACE. The project should be designed to meet the expected goals and objectives; it should not be manipulated just to fit under nationwide permit authorization.

John and Kristi asked about potential hydrological impacts of the project, specifically, are there potential aquifer interceptions or aquifer inputs, will surface runoff be affected by construction of the canal, and will current agricultural activities and property values be affected by the canal. These and similar issues should be included in the project documentation submitted to the USACE as part of the permit application to facilitate the USACE's evaluation of project impacts.

November 15, 2006

Ms. Moni DeVora Belton
U.S. Fish and Wildlife Service
17629 El Camino Real, Suite 211
Houston, Texas 77058-3051

Subject: November 3, 2006 Luce Bayou Field Visit

Dear Ms. Belton:

As a follow-up to the field visit conducted on Friday, November 3, 2006 to review the Luce Bayou project area, the intent of this letter is to document the discussions among the resource agency representatives and the Luce Bayou project team members relative to the use of Luce Bayou to convey water from the Trinity River to Lake Houston. The proposed project would involve construction of a pump station on the Trinity River that would serve as the point of diversion. Construction of a pipeline and canal section would connect the pump station to the headwater channel of Luce Bayou, where the water would then flow through the natural channel of the bayou into Lake Houston for treatment at the Northeast Water Treatment Plant and distribution to end users. A site map of the project area showing the nine identified project alternatives and a compilation of photographs from a previous field visit to Luce Bayou by the project team (October 4, 2006) were used as reference materials. A list of the names and telephone numbers of those in attendance at the field visit is attached.

Mr. Carell Freeman escorted the group on private property to view portions of Luce Bayou downstream of the confluence with Tarkington Bayou. The group also viewed the area of Luce Bayou west of its intersection with State Highway 321. Heavy rains occurring in the region during the month of October 2006 resulted in Luce Bayou reaching flood stage. Elevated flows within the Luce Bayou channel remained at the time of the site visit. Residual debris, silt, water lines, etc. were also apparent, indicating the extent of flood flows both within and outside of the channel.

General information about the anticipated timing and volume of flows within the channel were described in relation to the current channel configuration. Construction of a canal south of Luce Bayou was discussed as a potential alternative for conveying Trinity River water to Lake Houston.

Based upon the relatively pristine conditions observed for the downstream portions of Luce Bayou viewed during the site visit, the consensus of the resource agency representatives was that the canal alternative south of Luce Bayou should be pursued as the preferred route for the project since it would have less environmental impacts than modifications to the existing Luce Bayou channel. The potential loss of habitat and alteration of the character of the existing Luce Bayou channel were cited as reasons to focus on the southern canal alternative. Other concerns expressed included potential impacts to downstream portions of the Trinity River that may result from the diversion of water from the Trinity River basin, and the introduction of invasive species associated with the interbasin transfer of water. As discussed in the field, the issue of diverting water from the Trinity River has been addressed in previous studies performed as part of the Region H Regional Water Plan that accounted for the permitted diversion of Trinity River water into Lake Houston. Also, the resource agencies do not consider invasive species to be a significant issue, as the invasive species of concern are present within the watersheds of both rivers (Trinity River and San Jacinto River).

Based upon the observations made during the site visit and comments provided by the resource agency representatives, the Coastal Water Authority is moving forward with the project, identifying the

construction of a canal south of Luce Bayou as the preferred alternative rather than conveying water from the Trinity River to Lake Houston through the existing Luce Bayou channel. Please contact Ms. Kelly Krenz at 713 267-2849 or Ms. Anne Profilet at 713 432-7253 if there are additional topics or issues you would like to include to reflect the discussions and conclusion made during the site visit.

Sincerely,

Michael V. Reedy, PE
Project Director

MR:mc
Attachement

c: Gary Oradat, Coastal Water Authority
Catherine Yeargan, U.S. Fish and Wildlife Service
Lucia Lee, KBR
Anne Profilet, EcoLogic, Inc.

ATTENDEES
Luce Bayou Field Visit
November 3, 2006

Name	Organization	Telephone No.
Moni DeVora Belton	U.S. Fish and Wildlife Service	281 586-8282
Catherine Yeargan	U.S. Fish and Wildlife Service	281 586-8282
Jarrett (Woody) Woodrow	Texas Parks and Wildlife Department	281 534-0131
Jamie Schubert	Texas Parks and Wildlife Department	281 534-0135
Gary Oradat	Coastal Water Authority	713 658-9020
Jerry Berry	Coastal Water Authority	713 658-9020
Lee Casey	Coastal Water Authority	281 474-3395
Lucia Lee	KBR	713 753-3687
Anne Profilet	EcoLogic, Inc.	713 432-7253
Mike Reedy	TCB INC.	713 267-3127
Kelly Krenz-Doe	TCB INC.	713 267-2849
Michael Kane	TCB INC.	713 267-2886
Roy Knowles	TCB INC.	713 267-3117
Carell Freeman	Property owner	281 360-6703

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November 15, 2006

Mr. Jarrett "Woody" Woodrow
Texas Parks and Wildlife Department
1502 FM 517 East
Dickinson, Texas 77539

Subject: November 3, 2006 Luce Bayou Field Visit

Dear Mr. Woodrow:

As a follow-up to the field visit conducted on Friday, November 3, 2006 to review the Luce Bayou project area, the intent of this letter is to document the discussions among the resource agency representatives and the Luce Bayou project team members relative to the use of Luce Bayou to convey water from the Trinity River to Lake Houston. The proposed project would involve construction of a pump station on the Trinity River that would serve as the point of diversion. Construction of a pipeline and canal section would connect the pump station to the headwater channel of Luce Bayou, where the water would then flow through the natural channel of the bayou into Lake Houston for treatment at the Northeast Water Treatment Plant and distribution to end users. A site map of the project area showing the nine identified project alternatives and a compilation of photographs from a previous field visit to Luce Bayou by the project team (October 4, 2006) were used as reference materials. A list of the names and telephone numbers of those in attendance at the field visit is attached.

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Based upon the observations made during the site visit and comments provided by the resource agency representatives, the Coastal Water Authority is moving forward with the project, identifying the construction of a canal south of Luce Bayou as the preferred alternative rather than conveying water

from the Trinity River to Lake Houston through the existing Luce Bayou channel. Please contact Ms. Kelly Krenz at 713 267-2849 or Ms. Anne Profilet at 713 432-7253 if there are additional topics or issues you would like to include to reflect the discussions and conclusion made during the site visit.

Sincerely,

Michael V. Reedy, PE
Project Director

MR:mc
Attachment

c: Gary Oradat, Coastal Water Authority
William Schubert, Texas Parks and Wildlife Department
Lucia Lee, KBR
Anne Profilet, EcoLogic, Inc.

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November 3, 2006

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Michael Kane	TCB INC.	713 267-2886
Roy Knowles	TCB INC.	713 267-3117
Carell Freeman	Property owner	281 360-6703

Appendix D – Additional Table

Luce Bayou Interbasin Transfer Project
Alternative Analysis
Planning Level Cost Comparisons

The original Luce Bayou project is used as the basis for capital construction costs. The detailed plans for the pump station, pipeline, canal and downstream improvements originally developed by KBR in the 1980's were obtained. A detailed material takeoff was completed. Updated material, equipment and other construction costs were obtained from various sources including Means Estimating Guides, recent bid tabs, and conversations with contractors. These costs were used to develop an opinion of probable construction cost for the pump station, pipe line, canal and channel improvements.

In the table Constraints Analysis Phase Initial Planning Level Costs Comparisons, the opinion of probable construction costs are included in the third column. Unit costs for each of the four main areas of work were also developed as follows. The total length of the pipelines contained in the original plan was determined from the 1980's drawings. The opinion of probable construction cost for the pipelines ($52,301,235) was divided by the total length of pipelines (19,023 feet) to yield an equivalent unit cost of pipeline per mile ($14,516,665). Similarly the equivalent unit costs per mile of canal ($2,666,270), per mile of channel improvement ($943,706) and per MGD of pump station ($95,572) were developed. Based on review of the original plans, it was estimated that the amount of work required on the existing channel would be 100% greater than the effort reflected in the 1980's drawings. Therefore the unit cost per mile of channel improvement was increased to $1,887,422. The equivalent unit cost of the pump station was increased ($143,359) to account for greater Total Dynamic Head requirements.

The base capacity requirement is 400 MGD. The amount of raw water to be pumped was increased for each alternative utilizing open channel conveyance to account for potential evaporative and seepage losses. Therefore pump station and downstream facilities were adjusted accordingly for Alternative 1 (472 MGD), Alternative 2 (433 MGD), Alternative 3 (433 MGD), and Alternative 5 (411 MGD).

For alternatives pumping directly to the NEWPP (4a, 5a, and 6a), the amount of raw water required was assumed to be 50 percent greater than the base capacity to account for peak demands. For other alternatives the stored water in Lake Houston is used to provide additional water to meet peak demands, thereby only requiring average demand to be delivered. In addition to the pump stations, the pipelines for each of these alternatives (4a, 5a and 6a) were increased proportionately (dual 132) based on cross-sectional area of pipe and equivalent unit cost of pipeline per mile were also increased proportionately ($21,685,389).

For alternatives 5 and 6, the existing facilities located at the CWA Trinity River Pump Station were utilized to the extent as possible. Therefore equivalent unit costs only included anticipated improvements to increase pumping capacity and all ancillary needs. Items such as maintenance, utilities, residences, etc. were not included. Alternative 5a also included costs for the second pump station.

The equivalent unit costs were used in conjunction with the actual planned lengths of pipeline, canal and channel improvements and capacity of pump station to determine opinion of probable construction costs for each of the four main areas of work.

Contingency costs of 20 percent were added along with land and mitigation costs to develop the preliminary opinion of probable construction costs based on 2006 dollars.

Luce Bayou Interbasin Transfer Project
Project Constraints Analysis Phase Initial Preliminar
For Purpose of Comparing Alternatives Only
January 29, 2007

Capacity = 400 MGD									
Interest Rate = 6%	0.06								
Inflation Rate = 3%	0.03								
Alternative	Construction Costs (1)	Land Costs (1)	Mitigati Costs (1	ıual ıal nt. ts (10)	Other Annual Maint. Costs (11)	Total Annual Costs (12)	20 Yr PW Value (13)	30 Yr PW Value (14)
1	$195,000,000	$3,000,000	$8,40	750,000	$195,000	$9,945,000	$405,956,487	$452,926,389
2	$160,000,000	$4,500,000	$13,10	368,651	$160,000	$8,728,651	$351,860,279	$393,085,404
3	$175,000,000	$4,500,000	$4,50	375,795	$175,000	$8,750,795	$360,189,739	$401,519,453
4	$470,000,000	$5,000,000	$4,00	$0	$470,000	$9,270,000	$736,664,192	$780,446,091
4a	$940,000,000	$6,300,000	$6,30	$0	$940,000	$12,040,000	$1,369,874,797	$1,426,739,314
5	$355,000,000	$4,500,000	$4,50	437,063	$355,000	$7,192,063	$561,999,739	$595,967,613
5a	$720,000,000	$6,000,000	$6,00	445,341	$720,000	$9,770,341	$1,060,358,001	$1,106,502,994
6	$390,000,000	$4,000,000	$3,00	$0	$390,000	$8,590,000	$624,047,509	$664,617,791
6a	$665,000,000	$4,500,000	$4,50	$0	$665,000	$9,765,000	$987,778,542	$1,033,898,310

Capacity = 400 MGD								
Interest Rate = 6%	0.06							
Inflation Rate = 3%	0.03							
Alternative	Construction Costs	Land Costs	Mitigati Costs	ıual ıal nt. ts	Other Annual Maint. Costs	Total Annual Costs	20 Yr PW Value	30 Yr PW Value
1	$232,840,198	$3,582,157	$10,03	895,539	$232,840	$11,874,850	$484,733,276	$540,817,795
2	$191,048,367	$5,373,235	$15,64	634,240	$191,048	$10,422,465	$420,139,575	$469,364,529
3	$208,959,152	$5,373,235	$5,37	642,772	$208,959	$10,448,907	$430,085,385	$479,435,225
4	$561,204,579	$5,970,261	$4,77	$0	$561,205	$11,068,865	$879,615,570	$931,893,448
4a	$1,122,409,159	$7,522,529	$7,52	$0	$1,122,409	$14,376,390	$1,635,702,148	$1,703,601,354
5	$423,888,565	$5,373,235	$5,37	521,876	$423,889	$8,587,700	$671,057,079	$711,616,497
5a	$859,717,654	$7,164,314	$7,16	531,760	$859,718	$11,666,298	$1,266,122,907	$1,321,222,441
6	$465,680,396	$4,776,209	$3,58	$0	$465,680	$10,256,909	$745,145,361	$793,588,400
6a	$794,044,777	$5,373,235	$5,37	$0	$794,045	$11,659,921	$1,179,459,237	$1,234,528,651

Notes:
(1) From Table - Constraints Analysis Phase Initial Plar
(2) 25% of Construction + Land + Mitigation Costs
(3) Construction + Land + Mitigation + Engr./Financial/L
(4) Total Capital Costs annualized over 20 year period
(5) Total Capital Costs annualized over 30 year period
(6) Total Capital Costs annualized over 50 year period
(7) Total Capital Costs annualized over 75 year period
(8) Total Capital Costs annualized over 100 year period
(9) From Table - Pipeline Power Costs
(10) Unit cost of $75,000 per mile used based on O&M
(11) Other Annual Maint. Costs (pipeline, pump station,
(12) Total Annual Costs for Pump Station, Pipeline and
(13) Present Worth Value of Total Capital Costs and Tol
(14) Costs do not include secondary power supply

Luce Bayou Interbasin Transfer
Constraints Analysis Phase Initial Preliminary Rough Order of Magnitude Planning Level Cost Comparisons
For the Purpose of Comparing Alternatives Only
January 2007

Alternative	1	Base - Luce Bayou 1980 Design	2	3	4	4a	5	5a	6	6a
Flow, mgd	472	433	433	433	400	600	411	616	400	600
Construction Costs										
Pipeline Size	Dual 108	Dual 108	Dual 108	Dual 108	Dual 108	Dual 132	Dual 108	Dual 132	Dual 108	Dual 132
Pipeline Length	17570	19023	19023	19023	126293	167244	83718	122772	114153	130164
Base Pipeline Cost		$52,301,235								
Pipeline Cost Per mile	$14,516,665	$14,516,665	$14,516,665	$14,516,665	$14,516,665	$21,685,389	$14,516,665	$21,685,389	$14,516,665	$21,685,389
Pipeline Cost	***$48,306,403***	***$52,301,235***	***$52,301,235***	***$52,301,235***	***$347,225,983***	***$686,884,686***	***$230,171,623***	***$504,234,571***	***$313,848,651***	***$534,594,115***
Canal Length		12747	12747	96856			31352	31352		
Base Canal Cost		$6,436,920								
Canal Cost per Mile	$2,666,270	$2,666,270	$2,666,270	$2,666,270	$2,666,270	$3,999,404	$2,666,270	$3,999,404	$2,666,270	$2,666,270
Canal Cost	***$0***	***$6,436,920***	***$6,436,920***	***$48,909,887***	***$0***	***$0***	***$15,831,985***	***$23,747,978***	***$0***	***$0***
Channel Length	52800	53877	83606							
Base Channel Imp. Cost		$9,629,550								
Channel Imp.Cost Per Mile	$1,887,411	$943,706	$1,887,411	$1,887,411	$1,887,411	$1,887,411	$1,887,411	$1,887,411	$1,887,411	$1,887,411
Channel Imp Cost	***$18,874,111***	***$9,629,550***	***$29,886,154***	***$0***	***$0***	***$0***	***$0***	***$0***	***$0***	***$0***
Intake Size	Dual 108									
Intake Length	9,600									
Intake Cost Per Mile	$14,516,665									
Intake Cost	***$26,393,937***									
Base Pump Station Cost		$41,400,000					$46,600,000	$69,900,000	$11,600,000	$17,400,000
Pump Station Cost Per MGD	$143,359	$95,572	$95,572	$95,572	$95,572	$143,359	$113,438	$113,438	$29,000	$29,000
Pump Station Cost	***$67,611,556***	***$41,400,000***	***$41,400,000***	***$41,416,554***	***$38,228,964***	***$86,015,169***	***$46,600,000***	***$69,900,000***	***$11,600,000***	***$17,400,000***
Total Base	$161,186,007		$130,024,309	$142,627,676	$385,454,947	$772,899,855	$292,603,609	$597,882,549	$325,448,651	$551,994,115
Contingency	$32,237,201		$26,004,862	$28,525,535	$77,090,989	$154,579,971	$58,520,722	$119,576,510	$65,089,730	$110,398,823
Construction Total	$193,423,208		$156,029,171	$171,153,211	$462,545,936	$927,479,826	$351,124,330	$717,459,059	$390,538,381	$662,392,938
Use	$195,000,000		$160,000,000	$175,000,000	$470,000,000	$940,000,000	$355,000,000	$720,000,000	$390,000,000	$665,000,000
Land										
Pump Station Site	100		100	100	100	100	100	100		
Pipeline	121		131	131	870	1,152	577	846	786	896
Canal	0		88	667	0	0	216	216	0	0
Channel	364		576	0	0	0	0	0	0	0
Total	585		895	898	970	1,252	892	1,161	786	896
Land Cost	$2,923,209		$4,473,003	$4,490,324	$4,848,933	$6,259,091	$4,462,466	$5,807,300	$3,930,888	$4,482,231
Mitigation Costs	$8,377,755		$13,109,986	$4,490,324	$4,848,933	$6,259,091	$4,462,466	$5,807,300	$3,930,888	$4,482,231
Total Construction, Land and Mitigation Costs	$204,724,172		$173,612,160	$180,133,858	$472,243,801	$939,998,007	$360,049,261	$729,073,659	$398,400,157	$671,357,401
USE	$205,000,000		$175,000,000	$180,000,000	$475,000,000	$940,000,000	$360,000,000	$730,000,000	$400,000,000	$675,000,000

Assumptions

1 Base Luce Bayou - based on B&R design of 1980's - used for development of unit costs only
2 Estimated Channel Improvements assumed to be 100% greater that the base shown in the 1980 plan.
3 Flows are adjusted for seepage and evaporation losses
4 Alt 1 - Increase unit cost of pump station for higher head pumps
5 Alt 2 - based on total length of Luce Bayou (all will require channel modifications)
6 Alt 4a, 5a and 6a increase flows by 50% for 1.5 peak factor
7 Alt 4a, 5a, and 6a ratio pipe line costs by ratios of pipe cross-sectional area
8 Alt 5 and 6 - pump station costs only cost of new higher head pumps in existing structure
8 Alt 5a - river pump station cost same as Alt 5 + cost of second pump station at Highway 90
10 Land Costs - $5000 per acre - 300 foot wide for pipeline and canal
11 Mitigation Costs - $5000 per acre - 300 foot wide for pipeline and canal
$20,000 per acre - 300 foot wide for existing channel improvements

LUCE BAYOU PUMP STATION Date: 12/9/2005

Preliminary ROM Opinion of Probable Construction Cost - Based on 1980s Design Drawings

Turner Collie & Braden Job # 60003747-11001

	Item Number	Description	Unit	Quantity	Unit Price	Total Cost
Pump Station						
Structural	1	Control Building (62'-0" x 24'-0")	Sq ft	1,488	$140	$208,320
	2	Chlorine Building (36'-)' x 20'-0")	Sq ft	720	$140	$100,800
	3	Maintenance Building	Sq ft	4,458	$140	$624,120
	4	Residences (2)	Sq ft	3,029	$50	$151,450
	5	Ammonia building	Sq ft	720	$140	$100,800
	6	Sulfur Dioxide Building at Outfall	Sq ft	720	$140	$100,800
	7	HVAC for Buildings	L.S.	1	$20,000	$20,000
Civil	8	Clearing and Grubbing	L.S.	1	$48,150	$48,150
	9	Excavation & Hauling within on-site Force Main Boundary	C.Y.	56,056	$15	$840,842
	10	Backfill & Cement Stabilized Subgrade within onsite FM Bounda	C.Y.	17,323	$15	$259,852
	11	Excavation & Hauling for Pump Station foundation area	C.Y.	35,976	$15	$539,642
	12	Excavation & Hauling For Underground Fuel Tank Storage Area	C.Y.	1,540	$15	$23,100
	13	Pump Station Foundation Slab	C.Y.	783	$600	$470,000
	14	Pump Station Concrete Walls and Top Slabs	C.Y.	2,125	$600	$1,274,800
	15	Pump Station Barge	L.S.	1	$200,000	$200,000
	16	Pump Station Coffer Dam	Sq ft	9,000	$40	$360,000
	17	Pump Station Dewatering	L.S.	1	$20,000	$20,000
	18	Underground Storage Fuel Tanks Foundation Slabs	C.Y.	63	$500	$31,500
	19	Pea Gravel in Fuel Tanks Basin	C.Y.	1,441	$15	$21,615
	20	Site Access (2"-Asphalt Pavement)	Ton	779	$150	$116,919
	21	6-inch Lime Subgrade	S.Y.	7,086	$2.30	$16,298
	22	6-inch Lime Subgrade Stabilization	Ton	123	$120	$14,732
	23	8-inch Crushed Limestone	S.Y.	7,086	$17	$120,462
	24	Rip Rap at Intake Structure Bottom, 24" Thick	C.Y.	377	$42	$15,660
	25	Slope Protection, (Per Wally Burns, use Rip Rap 18" Thick)	C.Y.	668	$75	$50,079
	26	Sheet Pile (PZ27)	Sq ft	16,158	$35	$557,451
	27	HP 14 x 73 (2870 ft)	lb.	209,510	$3	$628,530
	28	60'-0" Cresoted Timber Piles	Sq ft	50,400	$35	$1,738,800
	29	Site Boundary Chain Link Fence (three barb wired)	L.F.	7,600	$15	$114,000
	30	Pump Station Chain Link Fence	L.F.	2,524	$15	$37,860
	31	Site Grading	A.C.	3	$2,000	$6,000
	32	Hydromulch Seeding	A.C.	3	$1,700	$5,100
	33	Safety Systems	L.S.	1	$10,000	$10,000
	34	Pollution Prevention	L.S.	1	$5,000	$5,000
	35	Drainage Swale (within Contract 200)	L.F.	2,740	$5	$13,700
	36	Mobilization & Misc. Civil	L.S.	1	$1,500,000	$1,500,000
Mechanical	37	Vertical Turbine Pumps rated at 49,600 gpm @ 108 ft TDH	EA	7	$1,275,000	$8,925,000
	38	Trash Rake at Intake Structure(TR-001)	L.S.	1	$4,771,173	$4,771,173
	39	Aluminum Access Hatches	L.S.	1	$5,000	$5,000
	40	Aluminum Hand Rails	L.F.	328	$30	$9,840
	41	48" dia. Ball Valves	EA	7	$273,236	$1,912,649
	42	48" dia. Butterfly Valves	EA	7	$28,856	$201,989
	43	108" dia Butterfly Valves	EA	2	$165,000	$330,000
	44	108-inch Valve Manholes	EA	2	$10,000	$20,000
	45	8" dia. Pressure Guage Assemblies	EA	7	$500	$3,500
	46	48" dia. CS Spool Pieces	EA	7	$3,000	$21,000
	47	8" dia. Combination Air Vacuum Valves	EA	7	$45,000	$315,000
	48	48" dia. Long Radius 90 degree Elbows	EA	7	$3,000	$21,000
	49	108" dia. CS Spool Piece (Discharge Header)	L.F.	90	$130	$11,700
	50	48" dia. Flanged Coupling Adaptors With Thrust Restraint	EA	1	$1,500	$1,500
	51	108" FM on site(Contract 200)	L.F.	3,210	$1,000	$3,210,000
	52	18" CMP(2 &2/3" x 1/2")	L.F.	74	$75	$5,550
	53	30" CMP (2 &2/3" x 1/2", 16 gage)	L.F.	40	$150	$6,000
		Underground Piping at Pump Station				

	Item Number	Description	Unit	Quantity	Unit Price	Total Cost
	54	2" Potable Water Lines	L.F.	2,400	$12	$28,800
	54	3" Potable Water Lines	L.F.	1,600	$15	$24,000
	55	4" Fire Water Lines	L.F.	150	$23	$3,450
	55	6" Fire Water Lines	L.F.	520	$25	$13,000
	56	3" Bearing Lube Lines	L.F.	1,325	$15	$19,875
	56	1/2" Raw Water Copper Tubing	L.F.	650	$10	$6,500
	57	6" Raw Water Line	L.F.	150	$25	$3,750
	57	6" Chlorine Solution Line	L.F.	150	$40	$6,000
	58	2-1/2" Hydraulic Lines	L.F.	25	$12	$300
	58	2" Hydraulic Lines	L.F.	25	$12	$300
	59	Pump Station Monorail (sheet 45)	LS	1	$5,000	$5,000
	59	Fire Pump System (Sheet 49)	LS	1	$50,000	$50,000
	60	Gas/Diesel Service Station (CI-54)	LS	1	$75,000	$75,000
	60	Miscellaneous P.S. Accessories (Sheets 34-37)	LS	1	$50,000	$50,000
	61	Potable Water System (Sheets 20+48+101+102)	LS	1	$200,000	$200,000
	61	Septic Tank & Drain Field (CI-55)	LS	1	$20,000	$20,000
	62	Pump Station Structure Coating, Coal Tar Epoxy	LS	1	$50,000	$50,000
	62	Access Ladder w/ Bilco Ladder Up Safety Post	EA	1	$10,000	$10,000
	63	Miscellaneous Mechanical	LS	1	$100,000	$100,000
	63	Instrument House (CI-56; II-06)	EA	1	$10,000	$10,000
Chlorination System		Chlorine Building (Shown in H9)				
	64	Chlorination System	L.S.	1	$1,100,000	$1,100,000
Ammoniation System		Ammonia Building (Shown in H12)				
	65	Ammoniation System	L.S.	1	$1,100,000	$1,100,000
Dechlorination System		Sulfur Dioxide Building (Shown in H13)	Sq ft			
	66	Sulfonation System	L.S.	1	$660,000	$660,000
Maintenance Area		Maintenance Building (Shown in H10)	EA	1	$250,000	$250,000
	67	Underground Fibergalss Fuel Tank (10,000gallons)	EA	2	$10,000	$20,000
	68	Vehicile Shed (2)	EA	2	$10,000	$20,000
	69	Crushed Limestones Pavement	LS	1	$50,000	$50,000
Operator's Residence		Operator Residence (Shown in H11)	EA	2	$150,000	$300,000
Subtotal						**$34,293,255**
Electrical & Instrumentation						
						$0
	70	**Electrical Subtotal (20% of Subtotal)**				$6,858,651
		SUBTOTAL				$41,151,906.28
		CONTINGENCIES (20%)				$8,230,381.26
		TOTAL ESTIMATED CONSTRUCTION COST				$49,382,287.54

LUCE BAYOU DIVERSION PROJECT

PROJECT CONSTRUCTION COSTS SUMMARY (2005 PRICES)

MOBILIZATION (5% of Construction Cost)	$	3,224,000
SUBTOTAL CANAL CONVEYANCE FACILITY	$	6,130,400
SUBTOTAL LUCE BAYOU CONVEYANCE FACILITY	$	9,171,000
SUBTOTAL PIPELINE CONVEYANCE FACILITY	$	49,180,700

SUBTOTAL PROBABLE CONSTRUCTION COST	**$**	**67,706,100**
20% CONTINGENCIES	**$**	**13,541,000**
TOTAL PROBABLE CONSTRUCTION COSTS	**$**	**81,247,100**

CANAL CONVEYANCE FACILITY

Item description	Unit	Unit qty.	Unit price	Total price
Canal Excavation & Grading	CY	343,810	$4.50	$ 1,547,100
Ditches Excavation & Grading	CY	15,640	$4.50	$ 70,400
Clearing & Grubbing	Acres	87	$10,000.00	$ 872,300
Hydromulch Seeding	Acres	84	$850.00	$ 71,400
Access Road (14' wide, 2" Asphalt Type "D")	Ton	2,210	$150.00	$ 331,500
Access Road (31' wide, 8" Crushed Lime Stone Base Course)	SY	44,470	$17.00	$ 756,000
Access Road (28' wide, 6" Lime Stabilized Subgrade)	SY	40,160	$2.30	$ 92,400
Lime for Subgrade Stabilization (7% Lime)	Ton	700	$120.00	$ 84,000
Compacted Embankment	CY	101,310	$5.50	$ 557,200
Fill in Waste Area	CY	242,500	$1.50	$ 363,800
Barbed Wire Fence, including Posts, gates, and wires)	LF	4,295	$16.00	$ 68,700
48" RCP Culvert	LF	200	$160.00	$ 32,000
42" RCP Culvert	LF	370	$120.00	$ 44,400
30" RCP Culvert	LF	70	$80.00	$ 5,600
24" RCP Culvert	LF	180	$70.00	$ 12,600
24" Drop Inlet	EA	2	$1,500.00	$ 3,000
4" Concrete Lining (Drainage Structure)	SY	550	$25.00	$ 13,800
1'-6" Concrete Lining (Drop Structure)	SY	1,660	$55.00	$ 91,300
12" Riprap	SY	800	$30.00	$ 24,000
6" Compacted Sand	SY	2,125	$2.00	$ 4,300
6" Concrete Lining at Tram Road	SY	90	$35.00	$ 3,200
12" Compacted Sand	SY	90	$3.00	$ 300
Concrete Bridge at Tram Road (16' wide x 78' long)	SF	1,248	$65.00	$ 81,100
Pipeline Adjustment/Relocation	Ea	5	$200,000.00	$ 1,000,000
				$ 6,130,400

LUCE BAYOU CONVEYANCE FACILITY

Item description	Unit	Unit qty.	Unit price	Total price
Channel Excavation & Grading	CY	1,663,690	$4.50	$ 7,486,600
Clearing & Grubbing	Acres	18	$10,000.00	$ 180,000
Hydromulch Seeding	Acres	18	$850.00	$ 15,300
Pipeline Adjustment/Relocation	Ea	3	$200,000.00	$ 600,000
Precast 7-foot by 7-foot box Culvert at FM 1008 Crossings	LF	372	$450.00	$ 167,400
6" Concrete Channel Lining at SH321 (Concrete Slope Paving)	SY	1,690	$35.00	$ 59,200
3" Type I Sand Fill at SH321	SY	1,690	$1.50	$ 2,500
Bridge Crossing at Kirby Forest Industries (16'-2" wide x 90' long)	SF	1,449	$65.00	$ 94,200
Access Roadway at Kirby Forest Industries (12' wide, 8" Crushed Lime Stone)	Ton	60	$1,400.00	$ 84,000
6" Concrete Channel Lining at Kirby Forest Industries (Concrete Slope Paving)	SY	430	$35.00	$ 15,100
3" Type I Sand Fill at Kirby	SY	430	$1.50	$ 600
Bridge Crossing at Champion (16'-2" wide by 100'-2" long)	SF	1,612	$65.00	$ 104,800
Access Roadway at Champion (12' wide, 8" Crushed Lime Stone)	Ton	130	$150.00	$ 19,500
6" Concrete Channel Lining at Champion (Concrete Slope Paving)	SY	1,790	$35.00	$ 62,700
3" Type I Sand Fill at Champion	SY	1,790	$1.50	$ 2,700
Bridge Crossing at Confluence (16'-2" wide by 90' long)	SF	1,451	$65.00	$ 94,300
Access Roadway at Confluence (12' wide, 8" Crushed Lime Stone)	Ton	100	$150.00	$ 15,000
6" Concrete Channel Lining at Confluence (Concrete Slope Paving)	SY	830	$35.00	$ 29,100
3" Type I Sand Fill at Confluence	SY	830	$1.50	$ 1,200
Bridge Crossing at Reidland (16'-2" wide by 100' long)	SF	1,612	$65.00	$ 104,800
Access Roadway at Reidland (12' wide, 8" Crushed Lime Stone)	Ton	50	$150.00	$ 7,500
6" Concrete Channel Lining at Reidland (Concrete Slope Paving)	SY	670	$35.00	$ 23,500
3" Type I Sand Fill at Reidland	SY	670	$1.50	$ 1,000
				$ 9,171,000

PIPELINE CONVEYANCE FACILITY

Item description	Unit	Unit qty.	Unit price	Total price
108-inch Steel Pipe, Open Cut	LF	31,360	$1,000.00	$31,360,000
108-inch Steel Pipe, Tunnel	LF	3,480	$3,300.00	$11,484,000
108-inch Butterfly Valve & Manhole (6000' cc)	Ea	7	$165,000.00	$1,155,000
Access Inlet Manholes	Ea	6	$25,000.00	$150,000
Pipe Drain Stations	Ea	8	$75,000.00	$600,000
Cathodic protection system, including test stations, insulating joints, etc. assuming electricity is available	LS	1	$200,000.00	$200,000
14" Slow Closing Air Vacuum Valve w/ Surge Check & Air Release - APCO Bulletin 613 (1900) - 3 Valves Ea. With 30" Pipe Riser (Type I)	Location	1	$95,000.00	$95,000
12" Slow Closing Air Vacuum Valve w/ Surge Check & Air Release - APCO Bulletin 613 (1900) - 3 Valves Ea. With 30" Pipe Riser (Type I)	Location	2	$80,000.00	$160,000
8" Slow Closing Air Vacuum Valve w/ Surge Check & Air Release - APCO Bulletin 613 (1900) - 2 Valves Ea. With 30" Pipe Riser (Type II)	Location	3	$45,000.00	$135,000
4" Slow Closing Air Vacuum Valve w/ Surge Check & Air Release - APCO Bulletin 613 (1900) - 2 Valves Ea. With 30" Pipe Riser (Type II)	Location	2	$32,000.00	$64,000
2" Combination Air Release Valves, APCO 1450 - 2 Valves Ea. With 30" Pipe Riser (Type III)	Location	3	$25,000.00	$75,000
2" Air Release Valve APCO #200A and One 2" Threaded Pipe with 2" Gate Valve and 30" Pipe Riser (Type IV)	Location	2	$13,000.00	$26,000
Access Road (14' wide, 2" Asphalt Type "D")	Ton	3,150	$150.00	$472,500
Access Road (28' wide, 8" Crushed Lime Stone Base Course)	SY	57,240	$17.00	$973,100
Access Road (28' wide, 6" Lime Stabilized Subgrade)	SY	57,240	$2.30	$131,700
Access Road (48 feet wide average, Compacted Embankment)	CY	32,710	$5.50	$179,900
Service Road (12' wide, 6" Lime Stabilized Subgrade)	SY	830	$2.30	$1,900
Lime for Subgrade Stabilization (7% Lime)	Ton	1,010	$120.00	$121,200
Service Road (18 feet wide average, Compacted Embankment)	CY	410	$5.50	$2,300
Clearing & Grubbing	Acres	120	$10,000.00	$1,200,000
24" Culvert	LF	720	$70.00	$50,400
30" Culvert	LF	120	$80.00	$9,600
48" Culvert	LF	60	$160.00	$9,600
Sedimentation Basin Excavation & Grading	CY	65,910	$4.50	$296,600
Concrete for Sedimentation Basin (8" thick)	SY	2,380	$35.00	$83,300
Grading and Compaction of Waste Area	CY	73,540	$1.50	$110,300
Excavation of Ditch & Grading	CY	7,630	$4.50	$34,300
				$49,180,700

Luce Bayou Interbasin Transfer Project
Draft Preliminary Channel Hydraulic Calculations Based on Gross Assumptions

Channel Bottom	Side Slopes	Channel Slope	Flow Depth	Normal Flow (cfs)	Normal Flow (mgd)	Mannings n	1.49/n	Area (sqft)	Perimiter (ft)	R2/3	S1/2
20	3	0.00057	1	4.98505	3	0.150	9.933333	23	26.32455532	0.913922	0.023875
20	3	0.00057	2	16.81888	11	0.150	9.933333	52	32.64911064	1.363834	0.023875
20	3	0.00057	3	35.24212	23	0.150	9.933333	87	38.97366596	1.708088	0.023875
20	3	0.00057	4	60.67503	39	0.150	9.933333	128	45.29822128	1.998792	0.023875
20	3	0.00057	5	93.65967	61	0.150	9.933333	175	51.6227766	2.256743	0.023875
20	3	0.00057	6	134.7684	87	0.150	9.933333	228	57.94733192	2.492417	0.023875
20	3	0.00057	7	184.5766	119	0.150	9.933333	287	64.27188724	2.711829	0.023875
20	3	0.00057	8	243.6529	157	0.150	9.933333	352	70.59644256	2.918747	0.023875
20	3	0.00057	9	312.556	202	0.150	9.933333	423	76.92099788	3.115695	0.023875
20	3	0.00057	10	391.833	253	0.150	9.933333	500	83.2455532	3.304446	0.023875
30	3	0.00057	1	7.340981	5	0.150	9.933333	33	36.32455532	0.93801	0.023875
30	3	0.00057	2	24.2096	16	0.150	9.933333	72	42.64911064	1.417825	0.023875
30	3	0.00057	3	49.58836	32	0.150	9.933333	117	48.97366596	1.787152	0.023875
30	3	0.00057	4	83.5776	54	0.150	9.933333	168	55.29822128	2.097723	0.023875
30	3	0.00057	5	126.5303	82	0.150	9.933333	225	61.6227766	2.371262	0.023875
30	3	0.00057	6	178.8927	116	0.150	9.933333	288	67.94733192	2.619194	0.023875
30	3	0.00057	7	241.1492	156	0.150	9.933333	357	74.27188724	2.848297	0.023875
30	3	0.00057	8	313.7996	203	0.150	9.933333	432	80.59644256	3.062924	0.023875
30	3	0.00057	9	397.3476	257	0.150	9.933333	513	86.92099788	3.266035	0.023875
30	3	0.00057	10	492.2957	318	0.150	9.933333	600	93.2455532	3.459731	0.023875
40	3	0.00057	1	9.703713	6	0.150	9.933333	43	46.32455532	0.951562	0.023875
40	3	0.00057	2	31.65383	20	0.150	9.933333	92	52.64911064	1.450795	0.023875
40	3	0.00057	3	64.0918	41	0.150	9.933333	147	58.97366596	1.838454	0.023875
40	3	0.00057	4	106.7957	69	0.150	9.933333	208	65.29822128	2.165001	0.023875
40	3	0.00057	5	159.9211	103	0.150	9.933333	275	71.6227766	2.452113	0.023875
40	3	0.00057	6	223.7787	145	0.150	9.933333	348	77.94733192	2.711484	0.023875
40	3	0.00057	7	298.7541	193	0.150	9.933333	427	84.27188724	2.950215	0.023875
40	3	0.00057	8	385.2713	249	0.150	9.933333	512	90.59644256	3.172958	0.023875
40	3	0.00057	9	483.774	313	0.150	9.933333	603	96.92099788	3.382928	0.023875
40	3	0.00057	10	594.7156	384	0.150	9.933333	700	103.2455532	3.582439	0.023875
50	3	0.00057	1	12.0696	8	0.150	9.933333	53	56.32455532	0.96025	0.023875
50	3	0.00057	2	39.12559	25	0.150	9.933333	112	62.64911064	1.473026	0.023875
50	3	0.00057	3	78.68271	51	0.150	9.933333	177	68.97366596	1.874449	0.023875

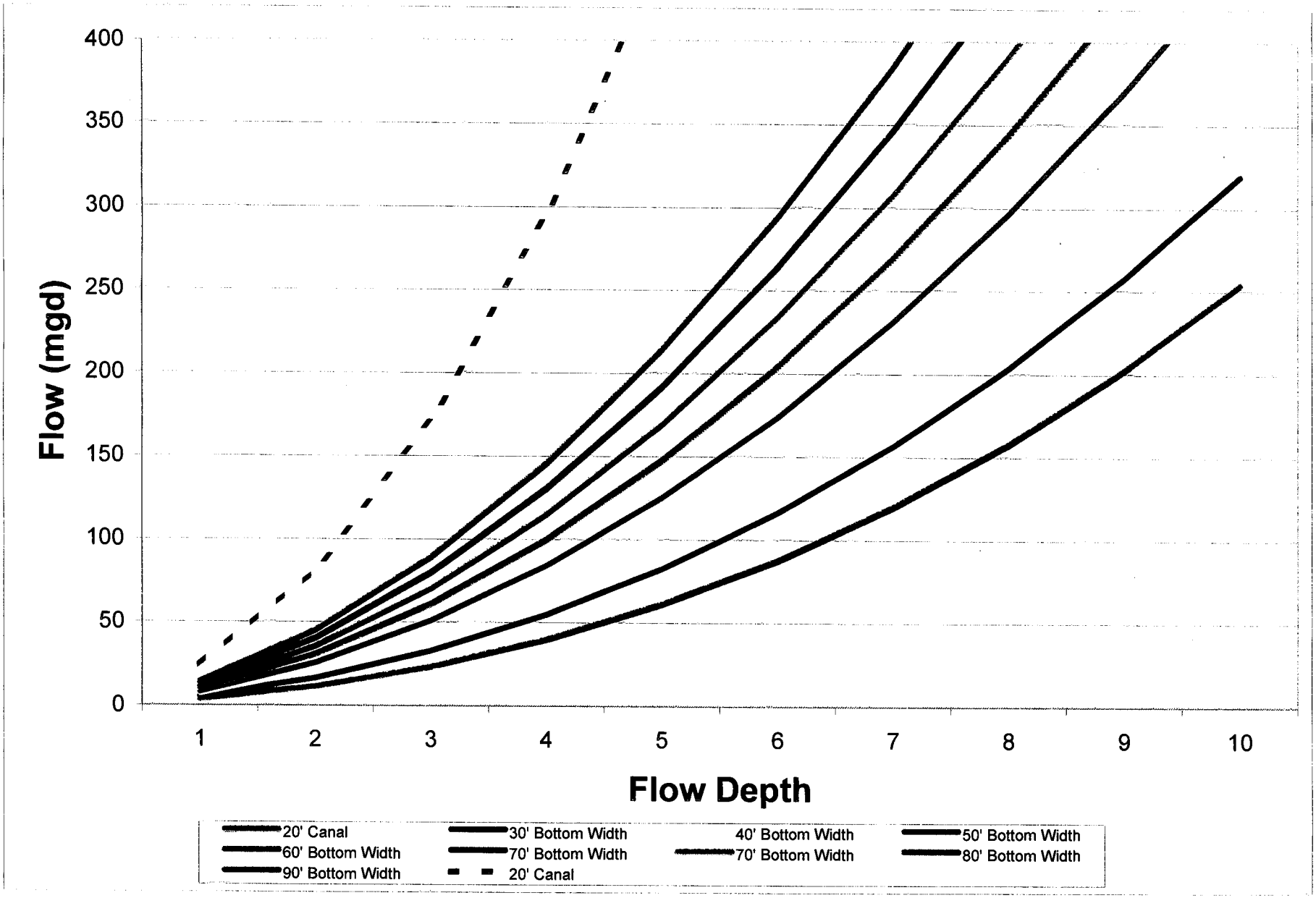
Luce Bayou Interbasin Transfer Project
Draft Preliminary Channel Hydraulic Calculations Based on Gross Assumptions

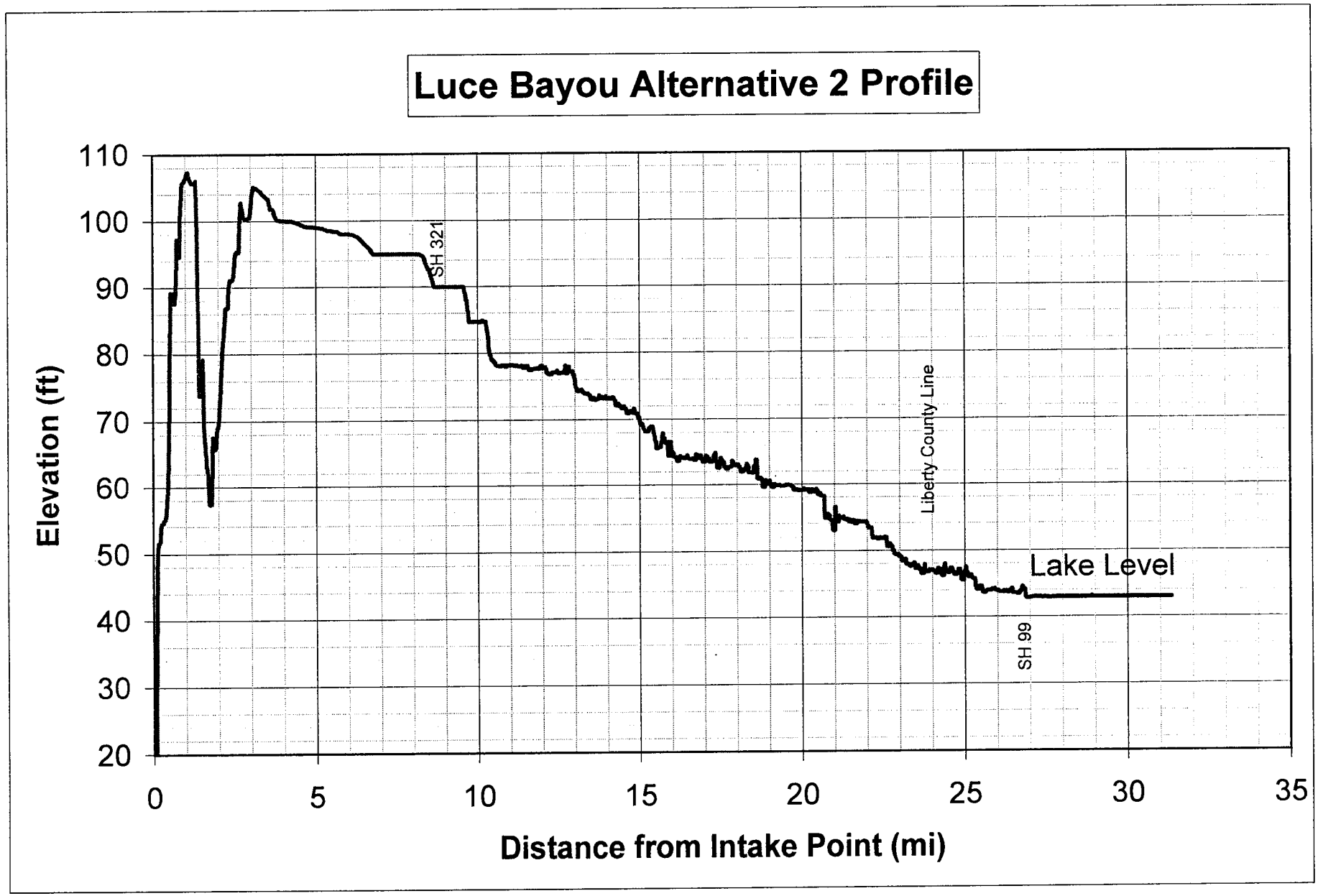
Channel Bottom	Side Slopes	Channel Slope	Flow Depth	Normal Flow (cfs)	Normal Flow (mgd)	Mannings n	1.49/n	Area (sqft)	Perimiter (ft)	R2/3	S1/2
50	3	0.00057	4	130.2005	84	0.150	9.933333	248	75.29822128	2.21375	0.023875
50	3	0.00057	5	193.635	125	0.150	9.933333	325	81.6227766	2.51228	0.023875
50	3	0.00057	6	269.1575	174	0.150	9.933333	408	87.94733192	2.781723	0.023875
50	3	0.00057	7	357.05	231	0.150	9.933333	497	94.27188724	3.029285	0.023875
50	3	0.00057	8	457.656	296	0.150	9.933333	592	100.5964426	3.259756	0.023875
50	3	0.00057	9	571.3552	369	0.150	9.933333	693	106.9209979	3.476486	0.023875
50	3	0.00057	10	698.5486	451	0.150	9.933333	800	113.2455532	3.681919	0.023875
60	3	0.00057	1	14.4372	9	0.150	9.933333	63	66.32455532	0.966296	0.023875
60	3	0.00057	2	46.6134	30	0.150	9.933333	132	72.64911064	1.489033	0.023875
60	3	0.00057	3	93.32731	60	0.150	9.933333	207	78.97366596	1.901104	0.023875
60	3	0.00057	4	153.7249	99	0.150	9.933333	288	85.29822128	2.250709	0.023875
60	3	0.00057	5	227.5635	147	0.150	9.933333	375	91.6227766	2.558815	0.023875
60	3	0.00057	6	314.8737	203	0.150	9.933333	468	97.94733192	2.836992	0.023875
60	3	0.00057	7	415.8313	269	0.150	9.933333	567	104.2718872	3.092443	0.023875
60	3	0.00057	8	530.6969	343	0.150	9.933333	672	110.5964426	3.330005	0.023875
60	3	0.00057	9	659.7832	426	0.150	9.933333	783	116.9209979	3.553097	0.023875
60	3	0.00057	10	803.4359	519	0.150	9.933333	900	123.2455532	3.764231	0.023875
70	3	0.00057	1	16.80585	11	0.150	9.933333	73	76.32455532	0.970745	0.023875
70	3	0.00057	2	54.11136	35	0.150	9.933333	152	82.64911064	1.50111	0.023875
70	3	0.00057	3	108.0072	70	0.150	9.933333	237	88.97366596	1.92164	0.023875
70	3	0.00057	4	177.3305	115	0.150	9.933333	328	95.29822128	2.279698	0.023875
70	3	0.00057	5	261.6419	169	0.150	9.933333	425	101.6227766	2.595888	0.023875
70	3	0.00057	6	360.8311	233	0.150	9.933333	528	107.9473319	2.881626	0.023875
70	3	0.00057	7	474.967	307	0.150	9.933333	637	114.2718872	3.144065	0.023875
70	3	0.00057	8	604.2254	390	0.150	9.933333	752	120.5964426	3.388042	0.023875
70	3	0.00057	9	748.8505	484	0.150	9.933333	873	126.9209979	3.616999	0.023875
70	3	0.00057	10	909.131	588	0.150	9.933333	1000	133.2455532	3.833487	0.023875
80	3	0.00057	1	19.17517	12	0.150	9.933333	83	86.32455532	0.974156	0.023875
80	3	0.00057	2	61.61616	40	0.150	9.933333	172	92.64911064	1.510545	0.023875
80	3	0.00057	3	122.7117	79	0.150	9.933333	267	98.97366596	1.937948	0.023875
80	3	0.00057	4	200.9939	130	0.150	9.933333	368	105.2982213	2.303046	0.023875
80	3	0.00057	5	295.8291	191	0.150	9.933333	475	111.6227766	2.626122	0.023875
80	3	0.00057	6	406.967	263	0.150	9.933333	588	117.9473319	2.918431	0.023875

Luce Bayou Interbasin Transfer Project
Draft Preliminary Channel Hydraulic Calculations Based on Gross Assumptions

Channel Bottom	Side Slopes	Channel Slope	Flow Depth	Normal Flow (cfs)	Normal Flow (mgd)	Mannings n	1.49/n	Area (sqft)	Perimiter (ft)	R2/3	S1/2
80	3	0.00057	7	534.3691	345	0.150	9.933333	707	124.2718872	3.187055	0.023875
80	3	0.00057	8	678.1263	438	0.150	9.933333	832	130.5964426	3.436804	0.023875
80	3	0.00057	9	838.4126	542	0.150	9.933333	963	136.9209979	3.671124	0.023875
80	3	0.00057	10	1015.459	656	0.150	9.933333	1100	143.2455532	3.892577	0.023875
90	3	0.00057	1	21.54495	14	0.150	9.933333	93	96.32455532	0.976855	0.023875
90	3	0.00057	2	69.12579	45	0.150	9.933333	192	102.6491106	1.518121	0.023875
90	3	0.00057	3	137.4337	89	0.150	9.933333	297	108.973666	1.951212	0.023875
90	3	0.00057	4	224.6998	145	0.150	9.933333	408	115.2982213	2.322255	0.023875
90	3	0.00057	5	330.0977	213	0.150	9.933333	525	121.6227766	2.651251	0.023875
90	3	0.00057	6	453.2385	293	0.150	9.933333	648	127.9473319	2.949303	0.023875
90	3	0.00057	7	593.9768	384	0.150	9.933333	777	134.2718872	3.223414	0.023875
90	3	0.00057	8	752.3178	486	0.150	9.933333	912	140.5964426	3.478356	0.023875
90	3	0.00057	9	928.3655	600	0.150	9.933333	1053	146.9209979	3.717562	0.023875
90	3	0.00057	10	1122.292	725	0.150	9.933333	1200	153.2455532	3.943593	0.023875
20	3	0.00057	1	37.38787	24	0.020	74.5	23	26.32455532	0.913922	0.023875
20	3	0.00057	2	126.1416	82	0.020	74.5	52	32.64911064	1.363834	0.023875
20	3	0.00057	3	264.3159	171	0.020	74.5	87	38.97366596	1.708088	0.023875
20	3	0.00057	4	455.0627	294	0.020	74.5	128	45.29822128	1.998792	0.023875
20	3	0.00057	5	702.4475	454	0.020	74.5	175	51.6227766	2.256743	0.023875
20	3	0.00057	6	1010.763	653	0.020	74.5	228	57.94733192	2.492417	0.023875
20	3	0.00057	7	1384.324	895	0.020	74.5	287	64.27188724	2.711829	0.023875
20	3	0.00057	8	1827.397	1181	0.020	74.5	352	70.59644256	2.918747	0.023875
20	3	0.00057	9	2344.17	1515	0.020	74.5	423	76.92099788	3.115695	0.023875
20	3	0.00057	10	2938.748	1899	0.020	74.5	500	83.2455532	3.304446	0.023875

Notes:
1. Channel slope based on overall length of open channel (18.25 miles) divided by the overall drop in elevation (55 feet).


400
350
300
250
200
150
100
50
0
Flow (mgd)
1
2
3
4
5
6
7
8
9
10
Flow Depth
20' Canal
30' Bottom Width
40' Bottom Width
50' Bottom Width
60' Bottom Width
70' Bottom Width
70' Bottom Width
80' Bottom Width
90' Bottom Width
20' Canal


Luce Bayou Alternative 2 Profile
Elevation (ft)
110
100
90
80
70
60
50
40
30
20
0
5
10
15
20
25
30
35
Distance from Intake Point (mi)
SH 321
Liberty County Line
SH 99
Lake Level

LUCE BAYOU
Pipeline Power Costs

1/29/2007

Alternative	Q (MDG)	Q (cfs)	dual Pipe Dia	Vel	Eqiv Dia	Length	C	hf	Discharge H	Suction H	Static H	TDH	Eff	$/kW-hr	Annual $
1	400	619	108	4.9	140.6	17570	110	12.8	263	158	105	118	0.9	0.15	$ 9,005,166
2	400	619	108	4.9	140.6	19023	110	13.8	102	22	80	94	0.9	0.15	$ 7,154,470
3	400	619	108	4.9	140.6	19023	110	13.8	102	22	80	94	0.9	0.15	$ 7,154,470
4	400	619	108	4.9	140.6	126293	110	91.9	45	22	23	115	0.9	0.15	$ 8,782,139
4A	400	619	108	4.9	140.6	167244	110	121.8	45	22	23	145	0.9	0.15	$ 11,059,966
5	400	619	108	4.9	140.6	83718	110	60.9	45	45	28	89	0.9	0.15	$ 6,788,364
5A	400	619	108	4.9	140.6	122772	110	89.4	45	45	28	117	0.9	0.15	$ 8,960,673
6	400	619	108	4.9	140.6	114153	110	83.1	45	21	24	107	0.9	0.15	$ 8,183,277
6A	400	619	108	4.9	140.6	131029	110	95.4	45	21	24	119	0.9	0.15	$ 9,121,975

Existing Trinity River Pump Station Canal Costs

Length of Canal	22	Mile Canal

Mowing

Equipment Description	Days/Year	Gallon of Diesel/Day	Cost of Diesel/Gallon	Cost of Diesel and Lubrication /Year*	Cost of Equipment Maintenance /Year**	Total Cost /Year
4 tractors w/ 15 ft wide mowers	200	144	$ 2.90	$ 92,178	$ 44,443	$ 136,622

Siphon Screen Cleaning

Equipment Description	# of Screens	Cleaning/Screen /Year	Total Cleanings /Year	Gallons of Diesel /Cleaning	Cost of Diesel /Gallon	Cost of Diesel and Lubrication /Year*	Cost of Equipment Maintenance /Year**	Total Cost /Year
Rubber tire hoe(Cat 420) ext. broom & clean out	3	52	156	3.87	$ 2.90	$ 1,926	$ 16,819	$ 18,745

Canal Vegetation Control

Equipment Description	Days/Year	Hours/Year	Gallons of Diesel /Hour	Cost of Diesel /Gallon	Cost of Diesel and Lubrication /Year*	Cost of Equipment Maintenance /Year**	Total Cost /Year
Long reach track hoe w/ 6' clean out bucket	200	1600	8.084	$ 2.90	$ 41,261	$ 44,200	$ 85,461

Canal Slide/Brake Repair

Equipment Description	Days/Year	Gallons of Diesel /Day	Cost of Diesel /Gallon	Cost of Diesel and Lubrication /Year*	Cost of Equipment Maintenance /Year**	Total Cost /Year
Long reach track hoe & D-6 wide track roller & sheep's foot roller	260	128	$ 2.90	$ 106,422	$ 103,700	$ 210,122

Labor Cost

Number of Workers	Hours/Day	Days/Year	Cost/Hour ($18.50 x 1.4)	Total Cost/Year
17	8	260	$ 25.90	$ 915,824

Input Information

Equiptment	Gallons of Diesel /Hour (0.043xMax PTO HP)	New Value (Unit Cost)	Turnover (years)	A (annual worth, based on P)
Tractor (105 HP)	4.5	$ 49,358.00	10	$ 38,273
Mower, Rhino (FL 15 Magnum)	0.0	$ 16,000.00	5	$ 18,657
Rubber tire hoe (Cat 420D), ext. boom, clean out bucket (90 HP)	3.9	$ 98,934.00	13	$ 19,179
Long reach track hoe CAT 324D L w/ 6' clean out bucket (188 HP)	8.1	$ 260,000.00	13	$ 50,402
Long reach track hoe, CAT 324D L (188 HP)	8.1	$ 260,000.00	13	$ 50,402
D-6 wide track roller CAT D6R Series II (185 HP)	8.0	$ 240,000.00	13	$ 46,525
Sheep's foot roller (131 HP)	0.0	$ 110,000.00	13	$ 21,324

Summary

O&M Task	Equipment Cost/Year	Total Cost /Year	Cost/Year /Mile
ROW/Reservior Mowing	$56,930	$136,622	$8,798
Siphon Screen Cleaning	$19,179	$18,745	$1,724
Canal Vegitation Control	$50,402	$85,461	$6,176
Canal Slide/ Brake Repair	$118,250	$210,122	$14,926
Labor		$915,824	$41,628
Total	**$244,760**	**$1,366,773**	**$73,252**

Cost of 1 Gallon of Diesel	$ 2.90

* Lubrication costs are equal to 10% of fuel Costs

** These cost include depreciation (10% of New Value), Interest (5% of NV), and Insurance/Housing (2% of NV). Values based on 10-Year Life

Luce Bayou Interbasin Transfer Project
Project Constraints Analysis Phase Initial Preliminary Rough Order of Magnitude Planning Level Present Worth Analysis
For Purpose of Comparing Alternatives Only
January 29, 2007

Capacity = 400 MGD — **2006 DOLLARS**
Interest Rate = 6% 0.06
Inflation Rate = 3% 0.03

Alternative	Construction Costs (1)	Land Costs (1)	Mitigation Costs (1)	Engr./Financial/Legal (2)	Total Capital Costs (3)	Annualized Capital Costs - 20 years (4)	Annualized Capital Costs - 30 years (5)	Annualized Capital Costs - 50 years (6)	Annualized Capital Costs - 75 years (7)	Annualized Capital Costs - 100 years (8)	Annual Power Costs(9)	Annual Canal Maint. Costs (10)	Other Annual Maint. Costs (11)	Total Annual Costs (12)	20 Yr PW Value (13)	30 Yr PW Value (14)
1	$195,000,000	$3,000,000	$8,400,000	$51,600,000	$258,000,000	$22,493,616	$18,743,419	$16,368,626	$15,678,317	$15,525,758	$9,000,000	$750,000	$195,000	$9,945,000	$405,956,487	$452,926,389
2	$160,000,000	$4,500,000	$13,100,000	$44,400,000	$222,000,000	$19,354,972	$16,128,058	$14,084,632	$13,490,645	$13,359,373	$7,200,000	$1,368,651	$160,000	$8,728,651	$351,860,279	$393,085,404
3	$175,000,000	$4,500,000	$4,500,000	$46,000,000	$230,000,000	$20,052,448	$16,709,250	$14,592,186	$13,976,794	$13,840,792	$7,200,000	$1,375,795	$175,000	$8,750,795	$360,189,739	$401,519,453
4	$470,000,000	$5,000,000	$4,000,000	$119,750,000	$598,750,000	$52,201,753	$43,498,536	$37,987,266	$36,385,241	$36,031,192	$8,800,000	$0	$470,000	$9,270,000	$736,664,192	$780,446,091
4a	$940,000,000	$6,300,000	$6,300,000	$238,150,000	$1,190,750,000	$103,815,011	$86,506,691	$75,546,284	$72,360,294	$71,656,187	$11,100,000	$0	$940,000	$12,040,000	$1,369,874,797	$1,426,739,314
5	$355,000,000	$4,500,000	$4,500,000	$91,000,000	$455,000,000	$39,668,973	$33,055,255	$28,867,150	$27,649,745	$27,380,697	$6,400,000	$437,063	$355,000	$7,192,063	$561,999,739	$595,967,613
5a	$720,000,000	$6,000,000	$6,000,000	$183,000,000	$915,000,000	$79,773,870	$66,473,754	$58,051,522	$55,603,333	$55,062,281	$8,605,000	$445,341	$720,000	$9,770,341	$1,060,358,001	$1,106,502,994
6	$390,000,000	$4,000,000	$3,000,000	$99,250,000	$496,250,000	$43,265,336	$36,052,022	$31,484,227	$30,156,452	$29,863,013	$8,200,000	$0	$390,000	$8,590,000	$624,047,509	$664,617,791
6a	$665,000,000	$4,500,000	$4,500,000	$168,500,000	$842,500,000	$73,452,989	$61,206,708	$53,451,811	$51,197,604	$50,699,423	$9,100,000	$0	$665,000	$9,765,000	$987,778,542	$1,033,898,310

Capacity = 400 MGD — **2012 DOLLARS**
Interest Rate = 6% 0.06
Inflation Rate = 3% 0.03

Alternative	Construction Costs	Land Costs	Mitigation Costs	Engr./Financial/Legal	Total Capital Costs	Annualized Capital Costs - 20 years	Annualized Capital Costs - 30 years	Annualized Capital Costs - 50 years	Annualized Capital Costs - 75 years	Annualized Capital Costs - 100 years	Annual Power Costs	Annual Canal Maint. Costs	Other Annual Maint. Costs	Total Annual Costs	20 Yr PW Value	30 Yr PW Value
1	$232,840,198	$3,582,157	$10,030,039	$61,613,099	$308,065,493	$26,858,553	$22,380,623	$19,544,995	$18,720,730	$18,538,567	$10,746,471	$895,539	$232,840	$11,874,850	$484,733,276	$540,817,795
2	$191,048,367	$5,373,235	$15,642,085	$53,015,922	$265,079,610	$23,110,848	$19,257,745	$16,817,787	$16,108,535	$15,951,790	$8,597,177	$1,634,240	$191,048	$10,422,465	$420,139,575	$469,364,529
3	$208,959,152	$5,373,235	$5,373,235	$54,926,406	$274,632,028	$23,943,672	$19,951,718	$17,423,833	$16,689,023	$16,526,629	$8,597,177	$1,642,772	$208,959	$10,448,907	$430,085,385	$479,435,225
4	$561,204,579	$5,970,261	$4,776,209	$142,987,763	$714,938,813	$62,331,624	$51,939,527	$45,358,783	$43,445,881	$43,023,128	$10,507,660	$0	$561,205	$11,068,865	$879,615,570	$931,893,448
4a	$1,122,409,159	$7,522,529	$7,522,529	$284,363,554	$1,421,817,772	$123,960,553	$103,293,513	$90,206,214	$86,401,975	$85,561,235	$13,253,980	$0	$1,122,409	$14,376,390	$1,635,702,148	$1,703,601,354
5	$423,888,565	$5,373,235	$5,373,235	$108,658,759	$543,293,795	$47,366,829	$39,469,703	$34,468,887	$33,015,241	$32,693,984	$7,641,935	$521,876	$423,889	$8,587,700	$671,057,079	$711,616,497
5a	$859,717,654	$7,164,314	$7,164,314	$218,511,570	$1,092,557,851	$95,254,172	$79,373,139	$69,316,553	$66,393,287	$65,747,243	$10,274,820	$531,760	$859,718	$11,666,298	$1,266,122,907	$1,321,222,441
6	$465,680,396	$4,776,209	$3,582,157	$118,509,690	$592,548,452	$51,661,074	$43,048,000	$37,593,814	$36,008,381	$35,657,999	$9,791,229	$0	$465,680	$10,256,909	$745,145,361	$793,588,400
6a	$794,044,777	$5,373,235	$5,373,235	$201,197,812	$1,005,989,060	$87,706,711	$73,084,010	$63,824,258	$61,132,617	$60,537,762	$10,865,876	$0	$794,045	$11,659,921	$1,179,459,237	$1,234,528,651

Notes:
(1) From Table - Constraints Analysis Phase Initial Planning Level Cost Comparisons
(2) 25% of Construction + Land + Mitigation Costs
(3) Construction + Land + Mitigation + Engr./Financial/Legal Costs
(4) Total Capital Costs annualized over 20 year period at given interest rate
(5) Total Capital Costs annualized over 30 year period at given interest rate
(6) Total Capital Costs annualized over 50 year period at given interest rate
(7) Total Capital Costs annualized over 75 year period at given interest rate
(8) Total Capital Costs annualized over 100 year period at given interest rate
(9) From Table - Pipeline Power Costs
(10) Unit cost of $75,000 per mile used based on O&M costs containted in Table - O and M Cost Estimate
(11) Other Annual Maint. Costs (pipeline, pump station, and other miscellaneous costs from open channel not previously identified) based on 0.1% of construction costs
(12) Total Annual Costs for Pump Station, Pipeline and Canal/Channel
(13) Present Worth Value of Total Capital Costs and Total Annual Costs at interest rate and inflation rate given
(14) Costs do not include secondary power supply